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MAIN READING ROOM

BENEFICIATION AND UTILIZATION OF MANGANESE DEPOSITS IN THE UNITED STATES

HEARINGS

BEFORE THE

SUBCOMMITTEE ON MINERALS, MATERIALS, AND FUELS

OF THE

COMMITTEE ON INTERIOR AND INSULAR AFFAIRS UNITED STATES SENATE

EIGHTY-FOURTH CONGRESS

FIRST SESSION

TO DETERMINE THE BEST METHODS AND MEANS OF UTILIZING THE MANGANESE DEPOSITS IN THE UNITED STATES

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UTILIZATION OF MANGANESE DEPOSITS IN THE UNITED STATES

TUESDAY, APRIL 12, 1955

UNITED STATES SENATE,
MINERALS, MATERIALS AND FUELS SUBCOMMITTEE OF
THE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS,
Washington, D. C.

The subcommittee met, pursuant to call, at 10 a. m., in room 224, Senate Office Building, Senator James E. Murray (chairman of the subcommittee) presiding.

Present: Senators James E. Murray, Montana; George W. Malone, Nevada; and Frank A. Barrett, Wyoming.

Also present: Jerome S. Adlerman, chief counsel of the subcommittee; George B. Holderer, staff engineer; and William C. Broadgate, metals and minerals consultant to the chairman.

The CHAIRMAN. Gentlemen, the other Senators will arrive in a few minutes, so I will proceed with the hearing this morning.

I am calling this hearing to determine the best methods and means of utilizing the manganese deposits in the United States. Manganese is one of the most strategic materials—without manganese, steel cannot be made—even though as little as 15 pounds of manganese is needed to make each ton of steel.

The United States uses approximately 2 million tons of manganese a year. Steel consumption has been rising steadily and the need for manganese will increase, particularly in wartime.

The stockpile figures are secret. But it is common knowledge that manganese constitutes one of the weakest items in our stockpile because of the huge quantities that must be acquired from abroad and transported over the sealanes.

The United States produces only a limited amount of high-grade manganese. However, there are vast reserves of low-grade manganese in the United States, over a 100 years' supply, located principally in Minnesota, Maine, Montana, New Mexico, Arizona, and the Ozark and Appalachian regions. These low-grade ores generally run from 6 percent to 15 percent manganese content. The minimum usable grade specified for the stockpile is 40 percent manganese content. The steel industry is now using approximately 46 percent grade, virtually all of which is imported.

At present almost all high-grade manganese is being imported from abroad. Prior to World War II, Russia was our traditional manganese supplier. With the onset of the war, Russia clamped down on her shipments of manganese and the United States was fortunate in finding available high-grade manganese in India. In wartime, India must be recognized as a very undependable source of supply for two reasons: (1) the long sea haul extending over many thousands of miles is very vulnerable to submarine and air attack; (2) there is grave likelihood that India will embargo shipments of manganese such as she has done in the past with monazite sands.

In the near future the Amapa manganese mine near the Amazon in Brazil will be in production. However, it must be recalled that during the early days of World War II, although Germany had only 100 old-type submarines, she managed to sink over 80 percent of our ore carriers in the Caribbean. The Soviet Government is reputed to have between 450 and 500 submarines, many of the latest snorkel-equipped type, which, undoubtedly will play havoc with our sealanes until brought under control by our air and naval forces.

Up to the present time the United States Government has spent $21,300,000 under the defense purchase program and has purchased from domestic sources 18,803,375 long-dry-ton units of manganese. This manganese cannot be used in its present state and will be useless in a war. It cannot be beneficiated after war starts, as labor, power and equipment will not be available.

There has been a research program under the direction of the General Services Administration. Some research has been conducted by the United States Bureau of Mines and a limited amount by private industry. All of the companies who have been appointed to do the research work are being called before the committee to explain their processes, the types of ore which their processes are to be applied to, and the measure of success that they have attained.

Thus far it appears that the research accomplishments have been rather limited and a more intensified and aggressive research must be undertaken. It is essential as a matter of national self-interest that means must be found to beneficiate and upgrade our domestic low-grade manganese ores to usable grade. This hearing has been called for the purpose of finding a means and methods to accomplish this purpose.

The first witness to be called is Mr. Norwood B. Melcher, Chief, Ferrous Metals and Alloys Branch, Bureau of Mines Assistant Secretary Wormser, who was originally scheduled to appear at 10 a. m., has postponed his testimony to 2 p. m. due to the pressure of duties. So Mr. Melcher will please come forward and take the stand.

Inasmuch as the testimony here is going to be quite technical, I would like to have the other Government agencies represented here to have their representatives sit around the table so they could quickly answer any question that may come up with which they would be familiar. I have in mind principally the Bureau of Mines people. Mr. Ralston, the chief metallurgist; Mr. Zinner, Mr. Royster, Mr. Conley, Mr. Clemmer, and Mr. Merrill.

If these gentlemen will sit around the table, they will be able to supply any evidence that we may need during the course of the testimony of the witnesses on the stand.

Mr. Shannon, also, should come to the table. He is from the Office of Minerals Mobilization.

The first witness is Mr. Melcher. You may state your full name and official position.

STATEMENT OF NORWOOD B. MELCHER, CHIEF, BRANCH OF FERROUS METALS AND FERRO ALLOYS, BUREAU OF MINES, DEPARTMENT OF THE INTERIOR

Mr. MELCHER. My name is Norwood B. Melcher. I am Chief of the Branch of Ferrous Metals and Ferro alloys, Bureau of Mines. I would like to present, if I may, a statement as to the general status

of the Bureau's current activities. I have some general information that may be of use to the committee with regard to manganese.

The CHAIRMAN. Very well, you may proceed.

CURRENT BUREAU OF MINES MANGANESE PROGRAM

Mr. MELCHER. Mr. Chairman, the Bureau of Mines keeps the manganese situation under close surveillance. In addition to its fact finding and other activities, an extensive manganese research program has been carried forward aimed principally at the development and utilization of domestic resources, most of which are low grade. I have a table showing the funds available to the Bureau of Mines for manganese research and investigation during the fiscal years 1952 through 1955, with an estimate for 1956.

The CHAIRMAN. You wish to have this printed in the record at this point in your testimony?

Mr. MELCHER. Yes, sir.

The CHAIRMAN. It may so be printed.

(The table referred to follows:)

Bureau of Mines manganese appropriations

Fiscal year 1956 (requested)	$786,565
Fiscal year 1955	786,565
Fiscal year 1954	869,415
Fiscal year 1953	588,675
Fiscal year 1952	1,182,055

Mr. MELCHER. Current research includes extensive work on new processes such as the acid-ferrous sulfate leach for mixed carbonate and oxide ores. In this process, the manganese and iron carbonates are leached with sulfuric acid to produce a liquor containing ferrous sulfate which then dissolves the manganese oxides. Considerable work is being done for General Services Administration in assaying and testing for amenability the low-grade ores received in the Butte-Philipsburg, Deming, and Wenden depots.

The oil emulsion flotation process developed by the Bureau in cooperation with private industry is used extensively in this work, and studies to improve the process are being made. Work continues on the sulfidization roast, the cyclic sulfur dioxide leaching, and other methods of treatment of Cuyuna range manganiferous materials; the chloridization of refractory Aroostook, Maine, material; the production of standard grade and new ferro-alloys by electric smelting of off-grade manganese ores and concentrates; and application of recent Bureau developed processes, such as the dithionate and caustic leach processes, to lower grade and more refractory ores.

Studies are continuing on chemical methods for the production of battery grade manganese dioxide, and on the beneficiation of various low-grade ores throughout the country. Both the Navy and industry have shown considerable interest in the high-damping manganese-copper alloys developed by the Bureau. Studies are also continuing on the properties of these alloys, and on the possible substitution of other elements for manganese in the production of steel; and, of course, the Bureau of Mines continues its important work of examination of manganese deposits and the development of additional reserves.

At that point, Mr. Chairman, I would introduce a table on estimates of domestic manganese resources, if you wish to have it.

The CHAIRMAN. The table will be received and printed in the record in connection with your statement.

(The table referred to follows:)

The 11 largest manganese deposits of the United States[1]

[Tonnages and grade are in most instances crude estimates, not based on extensive exploration]

District	Raw material	Metallic manganese	Average grade
	Tons	*Tons*	*Percent*
South Dakota, Chamberlain district	2,500,000,000	45,000,000	1–2
Minnesota, Cuyuna Range	500,000,000	25,000,000	5
Maine, Aroostock County	314,000,000	28,000,000	9
Arizona, Artillery Peak	[3] 195,000,000	[2] 7,500,000	4+
	15,000,000	[3] 975,000	6.5
North and South Carolina, Gaffney-Kings Mountain	25,000,000	1,000,000	3–4
Montana, Butte district	5,000,000	700,000	14
Colorado, Leadville district	4,000,000	600,000	15
Nevada, Three Kids district	5,000,000	500,000	10
Nevada, Pioche district	4,000,000	400,000	10
Montana, Philipsburg district	800,000	180,000	22.5
Arkansas, Virginia, Tennessee, Georgia, and Alabama	[4]	[4]	

[1] Excluding slags.
[2] All types of ore.
[3] Hard ore only. (Included in the 195,000,000 and 7,500,000 figures.)
[4] Insufficient data for estimation. Deposits are scattered and of variable character.

Mr. MELCHER. The manganese supply situation of the United States has improved greatly in recent years. Since the Russian embargo of late 1948, and the defense speedup following the invasion of South Korea, foreign production has increased to a level where there is an abundance on the world markets. United States Government purchases of foreign metallurgical ore are no longer being made and industrial stocks of ore have reached nearly a year's supply at the 1954 rate of consumption.

Developments now underway in the Western Hemisphere will add greatly to the United States potential supply. The Amapa deposits in Brazil can provide several hundred thousand tons per year, beginning in 1956 and deposits in Mexico are being developed which should soon add substantially to the potential supply.

The CHAIRMAN. Those are high-grade ores?

Mr. MELCHER. Yes, sir.

The CHAIRMAN. Would that together with the production that we have in this country furnish us a complete supply?

Mr. MELCHER. I would not say it would meet our total needs from just these sources. But they are blended with lower grades. Many of these will exceed 50 percent of manganese, and they are normally blended with lower grade ores.

The CHAIRMAN. Senator Malone, if you wish to ask any questions at any point, you are at liberty to do so.

Senator MALONE. Thank you, Mr. Chairman.

The CHAIRMAN. You, as chairman of this subcommittee formerly, originated these hearings, and I have very high respect for your ability in this field.

Senator MALONE. I appreciate your carrying on very much.

The CHAIRMAN. Thank you. You may ask any questions you wish.

Mr. MELCHER. The minimum strategic stockpile has been substantially exceeded in inventory accumulations and the long-range stockpile objective is being approached, taking into account probable deliveries under existing contracts and programs.

Under the stimulus of a Government-purchase program, and with the new production methods, domestic production of manganese ore

has doubled from the low year of 1951, even excluding the quantities of low-grade ores now being purchased at western Government depots.

Re-entry of Russian ore in world markets (with the exception of the United States) and the curtailment of American demand has resulted in a drop in the commercial price ranging from $1.08 to $1.10 per long ton-unit (c. i. f. United States port—duty extra) for ore of 48 percent mangenese content at the beginning of 1954 (and a high of $1.22 to $1.27 in 1952) to the current price ranging from 85 to 87 cents.

The CHAIRMAN. None of it comes to this country?

Mr. MELCHER. That is correct. And the curtailment of American demand has resulted in a drop in the commercial price from $1.08 to $1.10 per long ton-unit. These prices are United States port delivered, duty extra. The duty on ore from most countries is 5.6 cents a unit.

Senator MALONE. Do you mean duty on ore for our stockpile?

Mr. MELCHER. No. These are commercial prices, Senator. The duty, of course, does not apply to Government purchases. But it would be in addition to these prices for commercial purposes.

Senator MALONE. I misunderstood you. You do understand there is no duty paid on stockpile purchases of any kind of material?

Mr. MELCHER. That is correct, sir.

The CHAIRMAN. Does any of this Russian ore which is shipped to countries outside of the United States ever reach the United States?

Mr. MELCHER. No; to my knowledge none has come here. I might say that the duty on Russian ore is considerably more under a provision of the most-favored-nations clause. I understand the duty on ore from Russia, if it did enter this country, would be four times that of India, for example.

Senator MALONE. Will you explain for the record the original duty on the trades that have been made? In other words, what the duty is now, provided it is paid? It is not paid for the stockpile, but it is paid for private use. What would be the duty for the Russian?

Mr. MELCHER. That would be 1 cent per pound of contained manganese in the ore compared to one-fourth cent a pound duty for other countries.

Senator MALONE. With what country was this trade agreement made?

Mr. MELCHER. On the present one-quarter cent?

Senator MALONE. Yes.

Mr. MELCHER. It was reduced, as I remember, to a half cent with Brazil. I do not recall whether there was a particular country involved in the quarter-cent change or not.

Senator MALONE. Was that made at Geneva? Would you look that up for the record?

Mr. MELCHER. I would certainly be glad to look that up and provide it. My recollection on that is hazy.

Senator MALONE. That second trade was made under the second 50-percent allowance for trade agreements?

Mr. MELCHER. That is right.

Senator MALONE. First it was allowed to be lowered 50 percent, then it was lowered 50 percent. Then the next law, when the 1934 Trade Agreements Act was extended, there was an additional 50 percent, and that was also taken advantage of?

Mr. MELCHER. That is correct.

Senator MALONE. I think it would be helpful for the record if you could provide that information.

Mr. MELCHER. I have a history of the tariffs that I would be glad to provide at this point:

HISTORY OF THE DUTY ON MANGANESE ORE

Tariff Act of 1922, effective September 22, 1922. Manganese ore or concentrates, containing in excess of 30 percent metallic manganese, 1 cent per pound on the metallic content therein.

(Manganese ore can be shipped to the United States from Cuba free of duty under the commercial treaty made with Cuba in 1902.)

Tariff Act of 1930, effective June 18, 1930. Cost important change was the extension of the duty to include ore of 10 to 30 percent manganese content which previously had been admitted free.

(Ores from Cuba continued to be free of duty.)

Brazilian Trade Agreement, effective January 1, 1936. Under this agreement the duty on manganese ore, containing more than 10 percent manganese, was reduced from 1 cent to one-half cent per pound of contained manganese.

(Ores from Cuba continued to be free of duty.)

(Philippine Trade Act of 1946. Manganese ore from the Philippines comes in duty free. Apparently also came in duty free as far back as 1940.)

Geneva Conference of the International Trade Organization in October 1947, effective January 1, 1948. Cut rate in half to one-fourth cent per pound of contained manganese.

(Cuba and Philippines remained duty free.)

As a result of actions taken by the President under section 5, Trade Agreements Extension Act of 1951. The application of reduction in duty on imports from U. S. S. R. and Communist dominated or controlled areas was suspended, and the full rate of duty of the Tariff Act of 1930 (1 cent per pound of contained manganese) again became applicable to such imports.

Senator MALONE. Under what ruling was the decision made that there would be no duty collected on stockpile material?

Mr. MELCHER. My understanding on that is that the Government does not pay duty on anything. It is the collecting agency on duty, and I did not know that there was any particular law on that.

Senator MALONE. I am asking this for the record because it is important, Mr. Chairman. There is a law under which an Executive order was issued by the President of the United States—I cannot recall the time—a law of some kind, and if you would look it up to complete the record, I think it would be very helpful.

Mr. MELCHER. I will be glad to do that.

I am informed by GSA that the Federal Property and Administrative Services Act of 1949, as amended (40 U. S. C. 474 (6)), exempts General Services Administration from paying duty on its purchases of materials for the stockpile (only GSA and only for the stockpile).

Senator MALONE. There are people, Mr. Chairman, that are against a duty because they think it costs the Government more for stockpile. There is no duty collected.

Mr. MELCHER. The present price compared to early 1954 prices of approximately $1.10 is now in the range of 85 to 87 cents for comparable ore. The lower price has caused a drop in production in foreign countries and has been particularly felt by the small producers.

There was a decline of 38 percent in imports of manganese ore into the United States in 1954, as compared to 1953, and many foreign producers were unable to find markets.

If I may, I would introduce a table showing the domestic production of manganese ore in the United States by States for the past 5 years, showing the substantial increase in 1954.

Senator MALONE. Does that also show by deposit or by location within the States?

Mr. MELCHER. No, sir. That shows total for each State.

Senator MALONE. Do you have any figures that show the outstanding deposits and their production?

Mr. MELCHER. We have that information but, except for a few cases, we obtain that in confidence from the individual producer of a deposit and are unable to publish that.

Senator MALONE. Would it still be in confidence after you shut it down?

Mr. MELCHER. The information would still be in confidence. Although frequently we can obtain permission to show individual production, it requires a special request.

Senator MALONE. The imports have closed down 1 or 2 of the principal ones. I thought it might be good for the record if you could supply us as much data as you could.

Mr. MELCHER. I will be happy to prepare a table on the information we can show.

Senator MALONE. Thank you. You can give that to the committee in a confidential memorandum, could you not?

Mr. MELCHER. The promise we make is that it will be for the Department of the Interior only, Senator.

Senator MALONE. Very well. You do the best you can without violating any confidence.

Mr. MELCHER. Yes, sir.

The CHAIRMAN. Do you wish to have this table printed in the record at this point?

Mr. MELCHER. If you please.

(The table referred to follows:)

Manganese ore (35 percent or more Mn content) shipped from mines in the United States, 1950–54, by States, in short tons (excludes shipments to low-grade purchase depots)

State	1950	1951	1952	1953	1954 [1]
Alabama	138				
Arizona	222	173	203	[2]	
Arkansas	1,224	3,718	2,246	6,123	13,726
Baxter	(1,150)	(3,360)	(1,874)	(1,926)	(2,700)
California	37		8,081	5,413	831
Georgia					45
Missouri				[2]	
Montana	131,201	100,562	100,070	113,429	58,696
Anaconda	(119,694)	(91,080)	(90,773)	(102,878)	(44,770)
Trout Mining	(4,052)	(6,067)	(8,905)	(10,552)	(13,926)
Nevada		328	695	20,150	100,834
Manganese, Inc				(20,132)	(96,911)
New Mexico	1,320	226	2,360		
Oregon				46	
Tennessee	133		126	2,625	12,759
Texas			56		
Utah	120		95	550	
Virginia	56		1,011	8,454	23,147
Glade Mountain manganese				(1,314)	(2,628)
Old Dominion manganese				(1,542)	(1,866)
Washington			436	[3]	
Undistributed				746	
Total	134,451	105,007	115,379	157,536	210,038

[1] Preliminary.
[2] Included under "Undistributed."
[3] Small tonnage included under "Undistributed."

Senator MALONE. You could name the companies that have been closed down and the sources that have been closed down, could you not?

Mr. MELCHER. Yes. There are a great number of small operations that may be in operation for a year or a short period of time that would be down. I presume you mean the larger operations.

Senator MALONE. I think it would be helpful if you could do that.

Mr. MELCHER. Yes, sir.

I have perhaps too many tables here, Mr. Chairman, but they do present some interesting information on imports by countries, the consumption of manganese in the United States, the imports shown by Western Hemisphere as compared to total imports and the domestic production of manganese ore compared to consumption in terms of ore, which shows that since 1950 our total domestic production was only 7 percent of our consumption. This was virtually unchanged until 1953 and in 1954 reached nearly 13 percent of the consumption rate.

The CHAIRMAN. Do you wish to have this table printed in the record?

Mr. MELCRER. If it is all right, yes.

The CHAIRMAN. Does each table indicate what they cover?

Mr. MELCHER. Yes, sir.

The CHAIRMAN. The entire list will be carried in the record at this point. There are four tables, as I understand it.

(The tables referred to follow:)

Domestic production of Mn ore compared with consumption of manganese in terms of ore, 1950–54

Year	Domestic production [1]	Consumption of Mn ore; terms of ore	Percent of total domestic production to total United States consumption
1950	134,451	1,838,000	7.3
1951	105,007	2,121,000	5.0
1952	115,379	1,918,000	6.0
1953	157,536	2,254,000	7.0
1954 [2]	210,038	1,658,000	12.7

[1] Excludes shipments to low-grade purchase depots.
[2] Preliminary.

Consumption of manganese, in terms of ore, in the United States, 1950–54

[Short ton, in terms of ore]

1950	1,838,000	1953	2,254,000
1951	2,121,000	1954	1,658,000
1952	1,918,000		

Manganese ore (35 percent or more Mn) imported into the United States, 1950–54 (Western Hemisphere)

[General imports (short tons)]

	1950	1951	1952	1953	1954 [1]
Western Hemisphere	275,108	357,024	596,688	805,354	477,449
All other	1,559,817	1,410,556	2,072,092	2,695,632	1,688,695
Total	1,834,925	1,767,580	2,668,780	3,500,986	2,166,144

[1] Preliminary.

Manganese ore (35 percent or more Mn) imported into the United States, 1950–54, by countries

[General imports (short tons)]

	1950	1951	1952	1953	1954 [1]
Brazil	149,721	94,931	169,372	169,768	103,655
Cuba	96,917	147,086	259,230	397,257	261,537
Gold Coast	328,099	359,883	368,069	511,259	232,277
India	630,146	565,557	1,028,289	1,296,905	868,290
Union of South Africa	475,316	347,659	319,719	428,348	242,795
Other countries	174,726	252,464	524,101	697,449	457,590
Total	1,834,925	1,767,580	2,668,780	3,500,986	2,166,144

[1] Preliminary.

Mr. MELCHER. I have some ngures here showing a statement on deliveries under the various Government purchasing programs as of December 31, 1954. To that date were delivered the following long-ton units of manganese in the various domestic purchasing programs: Butte and Philipsburg, 1,418,058 units; Deming, 2,213,221 units; Wenden, 5,820,542 units; the carload purchase program, plus 40 per cent ore, was 2,275,617 units.

I might say that in addition to that, there was ore of plus 40 percent manganese that was delivered to the low grade depot by option of the producer, although he had to pay an extra freight cost. It was more expedient for him to ship it. Those figures are not in the high-grade ore so there was a little more production than the official data would indicate.

That completes my introductory statement, Mr. Chairman. If you have questions particularly regarding these processes, there are four engineers here from the Bureau of Mines who are completely familiar with the technology of these processes and our research work now underway.

Senator MALONE. Is the location of the stockpiles secret data?

Mr. MELCHER. My understanding is that it is.

Senator MALONE. And the amount of each stockpile would be confidential?

Mr. MELCHER. Yes, sir; these are classified.

Senator MALONE. Could you determine the degree of classification?

Mr. MELCHER. Senator, I am sorry. The stockpile of the low grade depots and the recent purchase programs is public information. The strategic stockpile, which constitutes material purchased under the Stockpiling Act, is classified data.

Senator MALONE. The public stockpile, that is to say, the location of the stockpiles to encourage production. If you had it in your statement, I missed it.

Mr. MELCHER. These last figures I showed were cumulative procurement for that period of time.

Senator MALONE. But you do not have the location of the stockpile.

Mr. MELCHER. Yes, sir.

Senator MALONE. In your regular statement?

Mr. MELCHER. Yes.

Senator MALONE. Did you read it in your regular statement?

Mr. MELCHER. Yes. That the Butte and Philipsburg were something over 1,400,000 units; Deming, New Mex., 2,200,000 units.

Senator MALONE. How many of these stockpiles do you have? You have more than three, do you not?

Mr. MELCHER. There are four.

Senator MALONE. Is that all?

Mr. MELCHER. No; there are actually only three. Butte and Philipsburg is one, Wenden and Deming, New Mex.

Senator MALONE. I understood over a period of several years, especially during World War II, you established many more than 2 or three stockpiles for manganese.

Mr. MELCHER. Back in World War II; yes. That was on the low grade, and many of those are still there.

Senator MALONE. Where are they?

Mr. MELCHER. I have a table showing the World War II stockpiles.

Senator MALONE. That was not part of your statement, was it?

Mr. MELCHER. No, sir.

Senator MALONE. Are those stockpiles still there and do you have manganese there?

Mr. MELCHER. Yes, sir; there are the quantities listed.

Senator MALONE. How many of them are there and where are they located?

LOCATION OF MANGANESE STOCKPILES

Mr. MELCHER. In long dry tons at Yreka, Calif., there was a small stockpile there of 223 tons, averaging 39 percent manganese. At Herlong, Calif., there is a total of 33,900 tons, approximately 39 percent manganese. At Hawthorne, Nev., approximately 18,000 tons, 39 percent manganese.

At Tooele, Utah, a total of 23,685 long dry tons, at 35 percent manganese. Drum Mountain, Utah, 6,600 tons, averaging approximately 29 percent manganese. At Deming, N. Mex., 70,000 tons, averaging 23.7 percent manganese. A grand total of 152,403 long dry tons, averaging 30.4 manganese.

Senator MALONE. That is all of the stockpiles that you have in the United States?

Mr. MELCHER. Of the subspecification grade.

Senator MALONE. Do you have others? Are there some with regular grades?

Mr. MELCHER. Yes, sir.

Senator MALONE. Where are they?

Mr. MELCHER. You mean imported ores?

Senator MALONE. I had in mind wherever they accepted domestic ores.

Mr. MELCHER. I really do not know whether GSA has released any data on that or not.

Senator MALONE. You could tell us how many of them there are?

Mr. MELCHER. No, I do not have that information here.

Senator MALONE. Does anybody we are going to hear have that information?

Mr. ADLERMAN. I believe the GSA people will have that information.

Senator MALONE. This includes all the stockpiles not handled by GSA. These are subgrade stockpiles?

Mr. MELCHER. These are subgrades. They have been under the jurisdiction of the GSA in recent years.

Senator MALONE. When were they established? Does your table show that?

Mr. MELCHER. During World War II, 1942 through 1945.

Senator MALONE. During that period they were built up and are they still accepting ores?

Mr. MELCHER. No, sir.

Senator MALONE. When did they quit?

Mr. MELCHER. Following the end of World War II at the time the Metals Reserve Co. went out of business.

Senator MALONE. What year?

Mr. MELCHER. The end of 1945.

Senator MALONE. Will you complete your record here as near as you can as to when you started in each case and when you discontinued the operation?

Mr. MELCHER. Very well, sir.

It might be well to insert this table in the record.

Senator MALONE. I think it would.

Mr. MELCHER. It shows the work we have done on the possible recovery of manganese from that ore and the total number of recoverable units using our processes.

The CHAIRMAN. This will be printed in the record at this point in connection with the testimony of the witness.

(The table referred to follows:)

Stockpile data—World War II stockpile [1]

	Long dry ton	Percent manganese grade	Percent recovery [2]	Recoverable units
Yreka, Calif.	223	38.8	83.9	7,259
Herlong, Calif.:				
Pile No. 1	8,250	43.9	100.0	362,175
Pile No. 2	4,000	34.6	73.0	101,032
Pile No. 3	1,600	30.1	68.1	32,797
Pile No. 4	20,050	34.9	91.3	638,867
Total	33,900	36.8	90.9	1,134,871
Hawthorne, Nev.	17,995	38.6	86.2	598,751
Tooele, Utah:				
Pile No. 1	21,405	34.0	91.1	662,998
Pile No. 2	2,280	44.7	100.0	101,916
Total	23,685	35.0	92.2	764,914
Drum Mountain, Utah	6,600	28.6	81.5	153,839
Deming, N. Mex.	70,000	23.7	75.0	1,244,250
Grand total	152,403	30.4	84.3	3,903,884

[1] Stockpiles at Yreka, Herlong, Hawthorne, and Tooele purchased manganese ore at minimum of 35 percent manganese. Stockpile at Drum Mountain purchased rhodochrosite ore at a minimum of 25 percent manganese. Stockpile at Deming purchased Lake Valley ore at a minimum of 20 percent manganese.

[2] Recovery based on fuel oil emulsion testing.

Senator MALONE. You mentioned $1.08 to $1.10 a unit for manganese. What year was that?

Mr. MELCHER. That was early in 1954.

Senator MALONE. When did that price break to the 85 cents that you were talking about?

Mr. MELCHER. It started, as I recall, early in last year. In other words, 1954. It dropped to even lower figures during the closing months of that year.

Senator MALONE. How low did it get?

Mr. MELCHER. It got as low as 70 or 75 cents a unit. Then it crawled back up again to this 85 to 87 cents.

Senator MALONE. Where would you say was the break-even point on domestic production, generally speaking? Of course, there are higher costs and lower costs. At what point would you get a considerable amount of domestic manganese providing there was some continuity of price either on a principle adopted by Congress with regard to the tariffs and duties or in a guaranteed price?

Mr. MELCHER. History shows that at competitive world prices, there has been some production from scattered mines, and we know that at Butte, Mont., the Anaconda Copper Co. was able to produce substantial tonnages at world prices.

Senator MALONE. What do you call world prices?

Mr. MELCHER. Competitive prices at that time were, as I recall, ranging from $1 to slightly higher per unit.

Senator MALONE. You were quoting 70 cents to 87 cents. What do you call that?

Mr. MELCHER. That is the more recent price.

Senator MALONE. That is the competitive world price?

Mr. MELCHER. I was thinking of the period following World War II up to the Korean emergency.

Senator MALONE. Right after World War II, they were trying to get the deposits throughout the world in operation again.

Mr. MELCHER. That is correct.

Senator MALONE. After they were in operation, would you not call that the world price, whatever it was, 80 or 70 cents?

Mr. MELCHER. Yes, sir.

Senator MALONE. Do you not think it is liable to get lower after they are all in operation?

Mr. MELCHER. I think it is conceivable, yes. It depends on the demand to quite a degree, Senator.

U. S. CONSUMPTION OF MANGANESE

Senator MALONE. The demand does not vary much. Are we not the main consumers?

Mr. MELCHER. We are the main consumers. For instance, our imports in 1954 dropped off very substantially.

Senator MALONE. They might drop off in 1 year but over a period of years you either build up or you decrease your stockpile.

Mr. MELCHER. Over a period of years, yes, sir.

Senator MALONE. Our consumption is pretty regular?

Mr. MELCHER. Our consumption is, I would say, increasing.

Senator MALONE. What does it run now?

Mr. MELCHER. Last year, as I recall, it was about 1,600,000 tons. The year before it was closer to 2 million tons.

Senator MALONE. What was it before World War II?

Mr. MELCHER. We used a figure of about 1,400,000.

Senator MALONE. Before World War II?

Mr. MELCHER. Yes, sir.

Senator MALONE. Then it has not varied much.

Mr. MELCHER. That was the peak. In other words, that was under full steel production.

Senator MALONE. Annual consumption under full steel production, yes. But at that time it was only about 75 or 85 million tons.

Mr. MELCHER. That is correct.

Senator MALONE. Now it is up around 100 million.

Mr. MELCHER. Yes, it exceeds that.

Senator MALONE. You say that 1,400,000 tons was consumed in about 1940?

Mr. MELCHER. Yes, sir.

Senator MALONE. Then it has only increased 200,000 tons in 14 years.

Mr. MELCHER. No. 1954 was a depressed year in steel production. At maximum steel output it would be closer to 2½ million tons.

Senator MALONE. You mean 1954 was a depressed year in steel production? What did they produce last year?

Mr. MELCHER. It was operating at somewhere about 75 percent of capacity rather than 100 percent. The total output was 88.3 million tons.

Senator MALONE. There is quite a spread between the 1,600,000 tons you first gave us and 2.5 million.

Mr. MELCHER. I am sorry if I confused you, Senator. The 1,600,000 was the 1954 rate of consumption when steel production was at approximately 75 percent of capacity.

Senator MALONE. What do you anticipate it will be this year?

Mr. MELCHER. It is running substantially higher and well in the nineties this year.

Senator MALONE. 90 percent?

Mr. MELCHER. Yes, sir. Manganese consumption at that rate will probably exceed 2 million tons.

Senator MALONE. This is contained manganese that you are talking about?

Mr. MELCHER. No, this is manganese ore, averaging 46 to 48 percent manganese.

Senator MALONE. How many tons of manganese when we talk about contained manganese?

Mr. MELCHER. It would be approximately half that or not quite half.

ADEQUATE PRICE FOR PRODUCERS TO BREAK EVEN

Senator MALONE. Where do you think the price would have to be? Do you think it could go below 70 cents a unit and the foreign producers could get along pretty well if they had a market?

Mr. MELCHER. Only some of them, sir.

Senator MALONE. Who are they?

Mr. MELCHER. The largest producers ship considerably lower in price than the small producers. In India—one of the largest suppliers is the ore from the Central Provinces Manganese Ore Co., the largest supplier—it is historically approximately 10 cents a unit below other offerings in India.

Senator MALONE. What do you think they could produce at and still maintain their operations?

Mr. MELCHER. I could not say. My guess would be something lower than that, but not too much.

Senator MALONE. Fifty cents a unit?

Mr. MELCHER. I would doubt it.

Senator MALONE. Sixty?

Mr. MELCHER. Perhaps something like that. That is a guess.

Senator MALONE. Where is the break-even point in America? I am speaking now about a substantial production.

Mr. MELCHER. That varies widely. I think it would vary from the market price where there would be some production to $2.30, which is the Government price.

Senator MALONE. That is the guaranteed price resulting from the bill we passed out of this committee?

Mr. MELCHER. Yes; at $2.30 a unit. That is yielding under that program slightly more than 200,000 tons a year. There are other operations that cannot produce at that rate. I mean other potential sources.

Senator MALONE. But if you had a long-range assurance of a price—either a guaranteed long-range price or a long-range principle established, under which imports would come in at $2.30 or $2.40—do you think there would be a substantial production in this country if you could look ahead 10 or 15 years for investments?

Mr. MELCHER. It would certainly help a marginal producer.

Senator MALONE. What do you call a marginal producer?

Mr. MELCHER. I was thinking of one that could see a profit at $2.30 but feels he would have to have it over an extended period of time to amortize his investment.

Senator MALONE. The purpose of this questioning, Mr. Chairman, is simply this: Many people get confused over the wages. They say we can get this cheaper from India than you can in the United States, but there is quite a spread in the wages, is there not?

Mr. MELCHER. There certainly would be.

Senator MALONE. What is that spread? Do you know?

Mr. MELCHER. No. I have heard of fantastically low wages in India.

Senator MALONE. What do you pay here to miners in the United States, generally speaking?

Mr. MELCHER. I think the miners could testify on that.

Senator MALONE. I am trying to get it from you. You are an expert—from this witness.

The CHAIRMAN. Some of the producers are here and they can give us expert testimony.

Senator MALONE. That is right. What I am trying to get at is this. You are paying $12 to $15 a day to miners.

Mr. MELCHER. That is certainly the approximate rate.

Senator MALONE. If you paid $1 to $1.50 a day in India, that would be a pretty fair price.

Mr. MELCHER. Yes, sir.

Senator MALONE. That marginal producer is very loosely applied. Anyone that pays wages that cannot produce as against India, with the very low living standards, is called a marginal producer in this country. I wanted to call attention to the fact that the difference in wages caused the margin. Is that correct?

Mr. MELCHER. That is correct. There are marginal producers even in India.

Senator MALONE. That, of course, is true. If you paid $1.50 a day here, you would probably get quite a few more deposits under the wire, could you not?

Mr. MELCHER. If you could find people at that rate.

Senator MALONE. I have listened to the marginal producer story for a long time. They say that the consumer is entitled to a lower price. Meaning that he is entitled to a lower-wage price. So, if you have any data at all—and I think you have done pretty well—on the $2.30, where you are getting 200,000 tons a year, it would be helpful.

Mr. MELCHER. Yes, sir.

Senator MALONE. That is a respectable production. They are getting that with no hope of a long-range program. That program runs out in 1958.

Mr. MELCHER. Yes, sir.

Senator MALONE. There could be no new investments in any new deposits. That is the point we wanted to bring out.

The domestic manganese deposits doubled since 1951. That is probably due to this legislation.

Mr. MELCHER. That is right.

Senator MALONE. It is about due for us to consider again if there is no better way of doing it.

I think that is all I have, sir.

CAUSES FOR DROP IN PRICE OF MANGANESE

The CHAIRMAN. Mr. Adlerman has some technical questions which he would like to bring out.

Mr. ADLERMAN. In the drop in the price to 85 cents that you mentioned a little while ago, did the stockpile purchases play any part in that?

Mr. MELCHER. Yes.

Mr. ADLERMAN. Do you feel that the competition they expect very shortly from the Brazilian mines may also have played a part in that?

Mr. MELCHER. A large part of it was the dropoff in shipments from high-cost operations in foreign countries on the lower price.

EXTENT OF LOW GRADE MANGANESE AVAILABLE IN U. S.

Mr. ADLERMAN. In the past hearings we have covered rather extensively the deposits of manganese in the United States. Is it generally conceded that we have more than 100 years' supply of low-grade manganese in this country if it could be beneficiated?

Do you prefer that question to be answered by Mr. Zinner?

Mr. MELCHER. No. The manganese is in the ground all right, Mr. Adlerman. If we could recover it and produce a usable manganese product, it would last for a good many years. I have not made the division to see whether it would be 100 or not.

Mr. ADLERMAN. I think we have had testimony in the past that that is so. Is one of the chief functions of the Bureau of Mines to do this research to find out whether or not they can upgrade this manganese?

APPROPRIATIONS FOR AND RESEARCH DONE ON UPGRADING MANGANESE ORES

Mr. MELCHER. That is one of our important functions, yes, sir.

Mr. ADLERMAN. What proportion of the appropriation are you spending for that, or how much are you spending for that?

Mr. MELCHER. Our current request for manganese is approximately $800,000 for this coming fiscal year.

Mr. ADLERMAN. How does that compare with the figure of 2 or 3 or 4 years ago?

Mr. MELCHER. It is higher. We had our maximum expenditure on manganese 5 years ago when we were operating the two very large-scale pilot plant operations, one to recover manganese from open-hearth slags and the other for recovering manganese from our low-grade ores. That was done at Boulder City, Nev.

Mr. ADLERMAN. How much was allocated at that time?

Mr. MELCHER. That was $1,192,000.

Mr. ADLERMAN. How much do you have for the past year?

Mr. MELCHER. $800,000.

Mr. ADLERMAN. It is quite a decrease.

Mr. MELCHER. That is correct.

Mr. ADLERMAN. Have you solved the metallurgical problems of upgrading the manganese?

Mr. MELCHER. We established that it is technically feasible to do so, both on the higher grade ores and from the open-hearth slags.

Mr. ADLERMAN. When you say feasible, is that commercially feasible?

Mr. MELCHER. No. The price would be higher than imported ores.

Mr. ADLERMAN. You feel that you have exhausted the avenues of research on that?

Mr. MELCHER. No, sir.

Mr. ADLERMAN. You feel that other research is necessary?

Mr. MELCHER. Yes, sir.

Mr. ADLERMAN. Do you feel that the amount of $800,000 is adequate?

Mr. MELCHER. It is adequate for a basic program. Of course, we could do more with additional funds.

Mr. ADLERMAN. You are well aware of the fact that in wartime we will not get any manganese from abroad. That is generally conceded by the Defense Department.

Mr. MELCHER. At least from distant sources.

Mr. ADLERMAN. And that we will have to rely on our own resources, is that correct?

Mr. MELCHER. I think in figuring the maximum stockpile as a long-range objective, it is conceded that we would obtain manganese ore from the United States, Cuba, and Mexico.

Mr. ADLERMAN. Do you think we will have enough to sustain ourselves if we do not get anything from abroad?

Mr. MELCHER. Not from current production.

Mr. ADLERMAN. Do you not think it is necessary that a more dynamic program be instituted to find ways of beneficiating manganese?

Mr. MELCHER. Yes, I do. I think it is essential to the United States to develop its manganese resources and to produce maximum tonnages from its low-grade ores over the long-range period.

Mr. ADLERMAN. Was the $800,000 the amount requested by the Bureau of Mines or was that the amount allowed to it?

Mr. MELCHER. That was the amount authorized in the President's budget.

Mr. ADLERMAN. How much had been requested before it went to the Budget Bureau?

Mr. MELCHER. I do not have that figure.

Mr. ADLERMAN. Can you give us the approximate figure?

Mr. MELCHER. That will be introduced here a little later. Each year it was frequently the same. Occasionally we had over ceiling items which we did not get.

Mr. ADLERMAN. How much money are you spending on exploration on manganese?

Mr. MELCHER. Very little, sir. Exploration activities of the Bureau are associated with the Defense Minerals Exploration Administration whereby producers contribute in a participation contract, and our work is restricted to very preliminary and casual inspections of properties.

Mr. ADLERMAN. Probably I should ask Mr. Ralston this question rather than you. At any rate, how long do you think it will take for research to solve the manganese metallurgical problems to a point where manganese might be commercially feasible?

Mr. MELCHER. Sir, in research on manganese, there is always room for improvement in processing. As time goes on, or there is not a year that goes by that we do not refine a process and make it more attractive. But it would be impossible to estimate the results of research to say when it would be commercially feasible.

Mr. ADLERMAN. Is the 200,000 tons now in the purchase program in a usable form?

Mr. MELCHER. Yes, that 200,000 tons is. That is apart from the low-grade depot program.

Mr. ADLERMAN. I am talking about the low-grade depot items. Is that in a usable form?

Mr. MELCHER. No, sir.

Mr. ADLERMAN. It is worthless until it is put in a usable form, is it not?

Mr. MELCHER. That is correct.

Mr. ADLERMAN. Is it not essential that some means be found to put it in a usable form?

Mr. MELCHER. Yes, sir. The Bureau has done a lot of work on that very problem.

The CHAIRMAN. Is anything being done now to put it into usable form?

Mr. MELCHER. We are exerting a great part of our manganese effort in that direction. We test the samples of all the materials delivered to the depots for General Services. We test for amenability for upgrading to usable form. We have done work on our own to develop processes for doing that job.

Mr. ADLERMAN. That is all I have, Mr. Chairman.

Senator MALONE. I would like to ask a couple of questions.

On these processes, are there several processes separate and distinct that you are operating or trying to work out or are actually using?

Mr. MELCHER. That is right.

Senator MALONE. Where are these low grade deposits? Is there one in Minnesota that has considerable possibility?

Mr. MELCHER. That is right.

Senator MALONE. What is that?

Mr. MELCHER. That is on the Cuyuna Range in Crow Wing County. It contains over 400 million tons of ore averaging 5 percent or slightly higher in manganese.

Senator MALONE. That is known 400 million tons?

Mr. MELCHER. Yes, sir.

Senator MALONE. Is there a process that you are working on now that might be successful?

Mr. MELCHER. We are working on a rather new process that I mentioned in my statement on sulfidizing roast, which has proved technically possible, but we have encountered many difficulties in doing that on a continuous basis.

Senator MALONE. You talked about commercial price. The commercial price again, Mr. Chairman, is a very loose term. The commercial price in the world price takes into consideration the wages of anywhere from 40 cents a day up to $3 or $4 a day. The commercial price in the United States takes into account perhaps $12 to $18 a day.

Let us take a specific price, such as the $2.30 price that is guaranteed in this bill up to 1958, a bill that this committee handled approximately 4 years ago. If they had a guaranteed price to potential producers of 10 years or some principle laid down so that they would be assured of a price, how would that apply to your unit range in the other areas?

Mr. MELCHER. By methods now known I doubt very seriously if large production can be obtained at $2.30 a unit.

Senator MALONE. Much above the 200,000 tons?

Mr. MELCHER. You asked me about the Minnesota deposit.

Senator MALONE. Yes. Let us confine ourselves to that area. From the methods now known it is not practical to do that?

Mr. MELCHER. Not at that price.

Senator MALONE. What would be the price, using the processes with which you are now experimenting?

Mr. FLETCHER. I would say it would be in excess of $3.

Senator MALONE. Do you think it will be possible to bring that price down?

Mr. MELCHER. That is the problem we are working on.

Senator MALONE. Do you believe you can be successful if you are given the opportunity and the money needed to continue the experiment?

Mr. MELCHER. We certainly have every hope that it will be. We think it is worth spending a substantial part of our manganese money on that specific project.

Senator MALONE. But would there be an incentive for private producers or potential producers to get into the work, providing there was some long-range principle established by Congress, or a guaranteed price under which they could hope to operate?

Mr. MELCHER. That is right. Obviously, someone approaching costs of $2.30 a unit would have a much better opportunity for success over a long-range period than a short one.

Senator MALONE. But when they are dependent entirely on a length of 2 or 3 or 4 years' duration, is there any real incentive to spend money in that kind of operation?

Mr. MELCHER. It would certainly limit that kind of capital.

Senator MALONE. Thank you, Mr. Chairman.

The CHAIRMAN. You will furnish any additional information which you have not been able to give at the time you were on the stand?

Mr. MELCHER. Yes. I have at least three items that I will specifically prepare for the committee.

The CHAIRMAN. We will have to speed up now because there are a number of other witnesses from the Bureau of Mines.

Mr. Ralston, I would like to have your appraisal of the research operations of the Bureau of Mines, if you could give us a brief statement.

STATEMENT OF OLIVER C. RALSTON, CHIEF METALLURGIST, BUREAU OF MINES, DEPARTMENT OF THE INTERIOR

Mr. RALSTON. My name is Oliver C. Ralston, chief metallurgist of the Bureau of Mines. Being a metallurgist, I am interested primarily in technology here, that is, economic technology. I want to review a little bit about manganese in war.

In World War I we were short of manganese. Mr. Royster, a colleague who is going to speak later, worked on the problem then. Government interest dropped when the war was over. We had a long hiatus when the Government did nothing about taking care of grievous shortages like manganese. The Government did go ahead on potash fertilizer, and by the time World War II came along we were self-sufficient. It was a combination of Government and industry that made that possible. It was not true of manganese.

In 1939 when we contracted to become the world's arsenal for democracy, one of the first things we did was to begin to look for more deposits. Most of what we found had already had their "eyes gouged out" for commercial ore but there remained much subgrade ore. That was the first place to look.

That meant development, first of all, of concentrative processes that would physically concentrate low grade ore and discard worthless materials associated.

The CHAIRMAN. Where were those deposits located?

Mr. RALSTON. All over the United States.

The CHAIRMAN. Every State in the Union?

Mr. RALSTON. Yes, sir. You have listed the main important areas in your opening statement. They need little modification. Almost continuously since that time—Korea came along early enough so that we had not dwindled down to nothing in our effort to solve the manganese problem—there has been something going on.

The CHAIRMAN. These little producers around the country were urging the Government at all times to do something about this, were they not? They were down here to Washington at different times in delegations begging the Government to do something.

PROBLEMS IN UPGRADING ORE

Mr. RALSTON. That is right. Many of them had been able to operate profitably during the war. Of course, price was the main incentive. Any administration that says "Let industry do it," the first thing they can do to help industry is an incentive. Price is the easiest in-

centive to put on. There are other incentives, but price, after all, is the overriding incentive.

It happens that manganese as it occurs in nature, when it is in high grade ores, is very easy to work with. Many ores are easily concentrated to something better if there is any reason for it. As you get into the low grade materials, there is a host of problems. The worst of those problems is slime sizes of particles, so small that physical concentration is next to impossible. Even the froth flotation process which is supposed to work on materials ground to 200 meshes to the linear inch, fails when you get down into what we call the micron sizes, where the material has the characteristics of clay and is mixed with clay and you cannot unmix it by any physical process known yet.

We are making advances into the solution of some slime problems. The manganese slimes have been very difficult, but in recent years there has been a considerable bite taken into that problem of getting part of the slimed manganese ore into a concentrate.

Every mineral beneficiator in the country has worked on the slime problem. It is general in all minerals. When you grind minerals, there is always a chance that you will produce a certain amount of unmanageable slime.

The CHAIRMAN. Has that system been employed in the Butte area?

Mr. RALSTON. I do not have the details on that. Mr. Clemmer, who is a mineral beneficiator and a hydrometallurgist, can answer when his turn comes.

The CHAIRMAN. I know there has been a beneficiating plant in the Butte area for many years.

Mr. RALSTON. Yes.

The CHAIRMAN. I understood that it was successfully operated and was able to produce a concentrate that was usable and was shipped throughout the country. I am not very familiar with it.

You may proceed, and we will get the testimony from someone else.

Mr. RALSTON. It would be better to get that from Mr. Clemmer.

Therefore, we have in manganese certain ores that will not respond to concentrating processes, and therefore metallurgy must come in, metallurgy that is chemical and not physical.

Mr. Royster, our pyrometallurgist, and Mr. Conley, and Mr. Clemmer are both hydrometallurgists. In other words, we use both fire and wet methods. They have all been working on projects that they will describe to you.

I will say that any low-grade ore can never compete successfully with ore from a mine where practically nothing has to be done to the ore but shovel it up. It is that type of ore that can supply a market at 70 cents per unit. You have to do more things to low-grade ores. Their costs must be higher. You have heard of the Cuyuna area with hundreds of millions of tons of material of 4 to 8 percent manganese. The metallurgist cannot do much with that until it is concentrated to some degree, though the metallurgist can do effective work on concentrates made from those low-grade ores.

Those low-grade ores must be treated at the deposit and pay no useless freight. Therefore, the lower the grade the more your obligation to find the concentrating process that will get you somewhere.

If a 5 percent ore can be raised to 20 percent concentrate without too much loss, as is possible on many of the Cuyuna range ores, the metal-

lurgist has a much better chance of coming up with something useful at least in wartime without perfectly ridiculous expense.

Let us just pick out of the air the assumption that in wartime we feel we can afford four times the price that you normally pay in order to get the excess demand supplied. That may not be the right figure, but it is reasonable. When we are in a war, we are in the war to win it, and the money flows out in just guarding ships moving foreign manganese ores. If you were to put in a bill from the Navy or Air Force on guarding the movement of ores, you would find that the cost of the delivered ore is an entirely different figure than the price paid to the producer.

So, as a metallurgist, I point out that we have been using both hydro and pyrometallurgy.

Mr. Royster has the history of the Mangaslag operation, which is a logical development of the things that he has gone through since World War I in Government and in industry. That is a smelting process.

Mr. Conley has worked on open-hearth slag with several other processes that are not smelting. They are partly pyrometallurgical and partly hydrometallurgical.

In the concentration of the ores, I should say that Mr. Clemmer has done more than anyone else in the Bureau of Mines and can tell you more, for instance, of the success of these Government purchasing depots, the testing of the ores offered for amenability. I think perhaps the most successful operation has been the one at Wenden where the average extraction possible in the form of a concentrate containing above 40 percent manganese has been an 80 percent recovery. I do not think that the indicated recovery of any of the other depots is as favorable as that. I may be corrected by Mr. Clemmer's testimony.

We do not wish to make a small amount of concentrate and leave 80 percent of the manganese in tailing, even though the concentrate we do squeeze out is of usable grade by the industry. That will be wasting our potential resource. We have not researched enough if there is an unmanageable 80 percent in a tailing. And there will always be something to be done on improving processes, particularly for cutting their costs.

First of all you have to get a process that will work and then begin to cut the corners off and bring the operating costs down. First of all it must work. In what we call pilot-plant stage and shakedown stage of an operating plant, you may have many months of very high-cost operations to attain an acceptable degree of technical success, even though it is not economic at the moment.

The metallurgist and the beneficiator require time both before an operation is started and after it is started. They must be exerting their effort continuously.

Does that answer the question?

The CHAIRMAN. You have given a very complete statement of the technicalities of this problem. Have you any recommendations you wish to make to the committee with reference to what should be done?

Of course, you have already told us that we have not done enough yet on the technical end of it in finding the method of beneficiating this low-grade ore.

PRICE AND INCENTIVE FOR FUTURE PRODUCTION

Mr. RALSTON. Yes. Where an ore can be concentrated at a profit, industry does it. Industry also tries to adapt what it has to ores that are a little beyond the economic edge. Most of the work that the Bureau of Mines has been doing has been on these castoffs that industry cannot handle under present technology and present economics. There is a great deal of work to be done to make this country self-sufficient. 200,000 tons a year is too small a fraction of what we need for us to feel safe.

The CHAIRMAN. Do you think that can be greatly expanded with proper research and technical advancement?

Mr. RALSTON. That is right. And always, not a ridiculous, but a substantial incentive in the form of price paid.

The CHAIRMAN. That sounds very reasonable, and I think that is the position that all the producers take; they need a little more money if they are going to be able to carry out the program. It seems to me that is what we will have to resort to if we are going to get the production we need.

Mr. RALSTON. It is hard to say how much we should raise that incentive. Is it enough right now if we just extend time? We do not want to keep wasting money. The bigger the incentive, the less the effort to meet it. We need a lot of effort. So the incentive should be raised very cautiously.

I think that the first trail, if you do anything is to see if the present incentive is not quite adequate, all we need to do is just name a longer period of years.

The CHAIRMAN. That seems very reasonable advice.

Are there any questions, Senator Malone?

Senator MALONE. We still come back to the matter of price and the incentive and how it should be arranged. Naturally, in peacetime you can get anything any place in the world. There is no drawback at all. If we had guaranteed peace, it would not be necessary to go to all this trouble, would it?

Mr. RALSTON. No. What we are doing is forging another weapon. Our supply of manganese is a weapon in war.

Senator MALONE. Let us take for granted that within a few years we will arrive at 100 million tons of steel a year. What is the average amount of manganese in a ton of steel?

Mr. RALSTON. Chairman Murray named 15 pounds of manganese in a ton of steel. That applies to certain steel, but it is not the grand average. We usually have less than 15 pounds of manganese to a ton. During Korea there were some plants making some grades of steel that got down as low as 10 pounds. There may be records of even lower that some of the industrial people may point out. After all, it is only a few pounds on a ton of steel.

Senator MALONE. You do have a pretty high amount of manganese in high-test steel, such as tool steel?

Mr. RALSTON. Yes. Especially if you alloy steel with manganese. We are cleaning the steel with manganese in what we are talking about, this average of something like 15 pounds or as low as 10.

Senator MALONE. 13 has been mentioned as an average. Would that be an average?

Mr. RALSTON. 13 pounds would have been an average in 1953, according to Mr. Royster.

Senator MALONE. If 13 pounds is in the average ton of steel that you are talking about, then that is absolutely necessary. There is no other metal that does the work.

Mr. RALSTON. Yes and no.

Senator MALONE. There is no other metal in common use where there is enough of it to do the work, is there?

Mr. RALSTON. First of all, the 13 pound average is such that we found we could use less. Part of that is insurance that you will not have trouble with the product. It is a little more than what is the minimum necessary.

Senator MALONE. That would be a safe average, would it?

Mr. RALSTON. Yes.

Senator MALONE. At $2.30 a unit in a long ton-unit, that would be 22 pounds per unit.

Mr. RALSTON. Yes.

Senator MALONE. That is around 10 cents a pound; 13 pounds would be about $1.30 on an average ton of steel. Is that about right?

Mr. RALSTON. That is right.

Senator MALONE. What we are trying to get at here is this: There is a good deal of loose talk about price when they are really talking about a low-wage living standard price from the foreign countries and world competition in arriving at a commercial competitive price. If it were $3 per unit on that same basis, it would be something around $1.80 or $1.90 a ton.

Mr. RALSTON. Yes.

Senator MALONE. I would ask you now, what is the average price for steel per ton?

Mr. RALSTON. I will ask Mr. Melcher to supply me with a figure.

Mr. MELCHER. For all grades, it probably would be around 7 to 7½ cents a pound.

Senator MALONE. Are you talking about long tons or short tons when you talk about steel?

Mr. MELCHER. Net tons.

Mr. RALSTON. Steel has gone off the long ton to the short ton, but they still buy their manganese by the long ton.

Senator MALONE. That is about $140 a ton. Then what we are actually talking about is about 1.5 percent of the cost. It is less than 1 percent cost on the $2.30. Would that be about right?

Mr. MELCHER. The price I gave is on steel products, Senator.

Mr. ROYSTER. That is the warehouse price of steel. The mill price would be about 4.5 cents or 5.

Mr. MELCHER. It is a little higher than that.

Mr. RALSTON. Ingot or liquid steel?

Mr. ROYSTER. Steel ingots.

Mr. MELCHER. The lower price is ordinary carbon steel. I was trying to give an average of all.

Senator MALONE. That would be $100 a ton.

Mr. ROYSTER. Yes, $100 a ton for mill price.

Senator MALONE. That would be a little over 1 percent for the $2.30 per unit, and if it went to $3, perhaps 1.5 percent. I want to point up what we are discussing. As a matter of fact, that is where you pay the regular wages in this country of $12, $15 and $16 a day. The 70 cents that you are talking about would be about three-quarters of 1 percent when you are talking about $1 a day wages or $1.50 a day.

I would like very much to get this down somewhere so we know what we are talking about. You know you can produce the manganese, I gather from the conversation, over a long-range period of years. It is a matter of price. Both of you have testified now that you can be successful in these experiments if you are given the money you need to carry them through.

The CHAIRMAN. They need the time to work out these technical advances, is that right?

Mr. RALSTON. Yes, sir.

Senator MALONE. You need the time period and some continuity. I remember crossing your trail for the last 25 years, Mr. Chairman. We are always trying to keep these experiments running but public sentiment runs high in war and runs low during peace. We are getting now 800,000 or 900,000 tons of manganese from India annually, are we not?

Mr. MELCHER. Yes, sir.

I think you struck an important point in that we have these periodic emergencies in manganese and everybody goes at it full blast and then it tapers off and it starts off again. This continuity that Senator Malone mentioned is very important in research.

Senator MALONE. It is important on 2 or 3 fronts. One is that you can develop your laboratory workers and keep them if you know you have a long-range program.

Mr. MELCHER. Exactly.

Senator MALONE. Another thing is that you can follow a process through.

You are talking to a committee of which 3 or 4 members have had some experience or at least some observation in watching this situation for 10 or 15 years. So, all in all, it would be a sympathetic committee, as our chairman said, if we could draw some conclusion from the evidence as to what we ought to do.

I am trying to draw the comparisons of cost. The cost of the finished product and our need in peace and our need in war. If we could become self-sufficient in wartime to do that, we would have to have some continuity in this production in peacetime, would we not?

Mr. MELCHER. That is right.

Senator MALONE. Then it would be impossible unless peace can be guaranteed for a long term of years to continue the way we are now without being in considerable danger, is that not correct?

Mr. MELCHER. For an increased domestic production, that is correct. For an emergency, anticipated supplies during the emergency, plus domestic production, plus material from the stockpile, could squeeze us through.

Senator MALONE. You are assuming a lot of things. What some of us would like to see would be a continuity of production so that the stockpile, whatever we determine it ought to be, plus the annual going concern, annual production, you are safe in any war. That is what we are looking for, is it not?

Mr. MELCHER. Yes, sir.

CAN U. S. BECOME SELF-SUFFICIENT IN MANGANESE?

Senator MALONE. We have to leave this to the military strategists, Mr. Chairman, but this committee went into that rather thoroughly. No one contended that you could get any manganese from India

during a war. That is where we are getting most of the manganese now. They do contend that you can get supplies from the western hemisphere, so it may be that we have something in South America.

I would like to ask this question of you, Mr. Ralston, because I know you are on top of it all the time. If you had this continuity of research money so that you could make plans 5 or 10 years or whatever you need in the future, is it your judgment that this Nation could be made self-sufficient in the production of manganese for an emergency? I am not talking about price. I will ask about that later.

Mr. RALSTON. I think we can make ourselves self-sufficient in time of war ultimately, forgetting price. I do not want to forget price entirely.

Senator MALONE. I am coming to that. I asked you this question first. You think we could?

Mr. RALSTON. Yes.

Senator MALONE. What is the time element in your judgment in this research that would be necessary?

Mr. RALSTON. Let me ask you, if you want a baby, how long is it going to take before you get it?

Senator MALONE. I have grandsons. I solved that question. You are the one we have to ask because those of us on the committee are temporarily with the responsibility. If you had a 5-year program, what could you do if you had sufficient money?

Mr. RALSTON. That would stimulate a certain amount of activity, but whoever got into building plants would not amortize them in 5 years.

Senator MALONE. You are talking about private industry?

Mr. RALSTON. Yes.

Senator MALONE. I am talking about Government. I am talking about the processes that you are working on.

Mr. RALSTON. But industry is going to produce the manganese by their own or somebody else's processes.

Senator MALONE. I am talking about the processes that you consider feasible. I will get into that in the next question. How long do you believe it would take to work out the processes so that in your judgment the next step could be taken, if the incentive were there?

Mr. RALSTON. Senator, that is a tough question.

Senator MALONE. I know it is. You are the man best qualified to answer that question that I know of. At least you know what these other men are doing and you know what private industry is doing. Take this deposit in Minnesota where it is generally believed that there are 400 or 500 million tons of 5 to 10 percent manganese.

Mr. RALSTON. That would average a little higher, but in that range.

Senator MALONE. What would be the time element if we just went to work on that one problem, although not confine the work to that problem, but have the money to do the job?

Mr. MELCHER. I would say that the processes now known are so complex that if you wanted to get really large production from that deposit for an emergency, as of now, it would take an awful lot of the 5-year period to get underway. It might not be worthwhile undertaking that.

Senator MALONE. How long?

Mr. MELCHER. We have found that it would probably take at least 2 years to construct a plant and probably it would take several months to design and another 6 months or a year to get the bugs out of it.

Senator MALONE. There would be 3 years gone before you really got started?

Mr. MELCHER. I am speaking of the 5 years that you mentioned, that would be largely eaten up.

Senator MALONE. How long would it take, if you had the money, to go ahead before you would have a practical operation worked out so that you could make a substantial production?

Mr. MELCHER. Maybe a total of 5 years.

Senator MALONE. Five more?

Mr. MELCHER. I was thinking of a total of 5 years. When I say "substantial," I do not mean we would get our full requirements or anything like that from that source.

Senator MALONE. Then, 3 years, and within 2 years you would have it worked out so that you could get a substantial production from that one operation. That is, from that one type of deposit.

Mr. MELCHER. I would think that would be a reasonable guess.

Senator MALONE. At least that is the way we have always operated up to now. Those processes could be used by private industry and it would take time to build their mills, would it not?

Mr. MELCHER. That is correct.

Senator MALONE. Then, where do you think that cost feature would land? Let us assume that we value money just like it is now. Maybe it will be and may be it will not be. But on the basis of $2.30 a unit, at the end of that 5 or 6 years, what would you think would be the cost of production there?

Mr. MELCHER. The initial guess would be probably considerably in excess of $2.30, probably in excess of $3.

Senator MALONE. Around $3 or $3.25?

Mr. MELCHER. Somewhere in that range.

Senator MALONE. In a large operation?

Mr. MELCHER. Yes, sir.

Senator MALONE. We are not talking about what it would cost you to produce it. That is money that goes to research.

Mr. MELCHER. I understand.

Senator MALONE. When a private enterprise would build a mill of large enough capacity, you still think it would be around $3?

Mr. MELCHER. I say I believe it would be in excess of that.

Senator MALONE. You have other deposits besides this one. You do think, Mr. Ralston, we could then in an emergency be self-sufficient?

Mr. RALSTON. That is one assumption, one process for one plant. We would not be self-sufficient except on paper.

Senator MALONE. Could you run more than one at a time if you had the money?

Mr. RALSTON. Certainly.

Senator MALONE. I am talking about the time element now and money to do it.

Mr. RALSTON. I still want to see amortization, if industry does it. If the Government has to guarantee amortization, that is another thing. Or if the Government will guarantee 50 percent of amortization.

Senator MALONE. Let us leave that to the future, because the Government does what it has to do when it is in trouble. When would you be ready, if you had the money that you need, to go into these various deposits and get ready to build the kind of mill that we are talking about that we hope would be finished in private industry? Could it be done in 5 or 6 years?

Mr. RALSTON. I think it could on, say, the Cuyuna Range and the open-hearth slags.

Senator MALONE. The open-hearth slags take about the same length of time?

Mr. RALSTON. Yes.

Senator MALONE. Where do you think the price would range in the open-hearth slags in the production per unit of manganese?

Mr. RALSTON. I think they need the $2.30 incentive.

Senator MALONE. And you think that would be enough, if you had the money for research and experimentation for the next 5 or 6 years? Do you?

Mr. RALSTON. From those two sources you could ultimately get a tremendous amount of manganese.

Senator MALONE. At that price?

Mr. RALSTON. Yes, sir.

Senator MALONE. Do you think you would be close to self-sufficiency then, at the end of the time that you could build the necessary mills?

Mr. RALSTON. Who would build the mills but the Government?

Senator MALONE. We will talk about that when we get there. I am talking about the time element the Government needs to get into position so that the private industry could see that they could produce enough in wartime and at an estimated price of $2.30 or $2.50 or whatever it happens to be.

Mr. RALSTON. To get a going domestic industry it must be on a higher price than the world price.

Senator MALONE. Of course, we know that. That is axiomatic. That is the reason I stay up nights and do not get any sleep.

Mr. RALSTON. I have put emphasis on the time rather than on a large incentive. There has to be a price incentive but over a longer time the smaller the incentive needs to be.

Senator MALONE. Let us forget the incentive. We are talking about 5 or 6 years. Let us say in 6 years the Government could get in position, if it had the money— and no doubt you could estimate what that would be for the 2 or 3 different methods, one of them the Cuyuna Range and the reduction of the open-hearth slag—do you think the two of them would do the work?

Mr. RALSTON. Five years would get answers, but not the necessary complete utilization.

The CHAIRMAN. Let me ask you a question there. If the Government wants to find some way of handling this problem and determining what should be done to get sufficient production of manganese in this country to operate our American economic system, would it not be better for a commission to be set up of experts in this field and would not they be able to work the problem out better than some of us? Of course, Senator Malone is an engineer. He has been studying this for some years. He is well qualified. But I think there ought to be other engineers sitting on the committee in order to work out the kind of program that we want, to provide the United States with a workable economy so far as manganese is concerned. Do you think that would be the correct way of doing it?

Mr. RALSTON. It is a correct way.

The CHAIRMAN. It is "a" correct way?

Mr. RALSTON. Yes.

The CHAIRMAN. Another way is to have Congress experiment with it and provide a program, and if it works, it will be satisfactory, and if not, we will try something else. For example, as President Roosevelt said during the years of depression, when business had thrown up its hands and was unable to determine what should be done, "We will try something, and if it doesn't work, we will try something else."

It seems to me that there ought to be some expert way of handling it.

Mr. RALSTON. That is right.

Senator MALONE. Mr. Chairman, you have some of the best experts right in front of you, and they will work for a committee headed by you, if we will let them.

The CHAIRMAN. I realize that. I have great respect for them. I think they are the ones who will have to tell us what to do about this matter.

Senator MALONE. If we could get an estimate. The final question in this series is: What would the annual cost be for 5 years to run both of these experiments, the Cuyuna Range and the open-hearth slag? Congress can only commit itself for the 2 years, but I have never seen Congress turn down anything when they really were convinced it was necessary. You could make that estimate, could you not?

Mr. RALSTON. We can make up an estimate, yes, on two such projects.

Senator MALONE. Could you do it for this committee in the next week or so?

Mr. RALSTON. It would be a guestimate.

Senator MALONE. How long would it take to make a real estimate?

Mr. MELCHER. Is that for the cost of the full operation, Senator? Or just research?

Senator MALONE. I am talking about a 5-year research program. How much money would you need? It is not necessary to tell us what kind of engineers you would use. That is up to you. You spent your life in it.

Mr. RALSTON. A 5-year research program including pilot planting?

Senator MALONE. Whatever is needed.

Mr. ROYSTER. Is that to be carried on by the Government itself?

Senator MALONE. I think so. If you could get it done by some other way later, that would be a future operation. Just so you know you could go through and arrive at something. I have been here for 9 years and nothing has been done yet. Let us put it on the line, Mr. Chairman. Why do not we do that? How soon could you come in with that estimate?

Mr. MELCHER. You would not restrict it to only those two sources?

Senator MALONE. No. You are the ones who know what formulas you want to use and what processes you want to perfect. I have been listening to this for 30 years, and 9 years here. We have a hearing, or someone else had it before I came here, and then it fades out like a radio, and nothing happens.

The CHAIRMAN. I am anxious to have something like that done because if you stay here another 30 years and you die, then we will be up against it. I think we ought to begin now to provide some plan whereby we will not get——

Mr. MELCHER. You cannot solve all these problems in 5 years.

Senator MALONE. I asked you about it, and you told me 5 or 6 years. Now you come in with a time element for each one of them, if you have 20 processes. Am I at liberty to say this?

The CHAIRMAN. Yes. Say anything you want, because you have judgment.

Senator MALONE. This is the mining department we are speaking about, the great Federal Bureau of Mines. I have known Dr. Ralston for 25 years at least. I will not go too far because they will think we are too old, Oliver. I know he can handle this thing. I know these men working with him can handle it. Let us ask him, Mr. Chairman, to come in with as many of these processes as they think they can logically handle over a 5- or 10-year program, indicating how soon they can get the results that we need, including pilot plants and anything that is necessary.

Then we will get into financing. I have some ideas of my own. If we would just quit trying to take care of all the world and take care of some people in the United States of America, we would be a lot better off.

The CHAIRMAN. Now you have given the Bureau of Mines engineers a problem for them to try to work out for them and they will submit statements to us. How long would that require?

Mr. RALSTON. We have difficulty getting people in the Government to work. If you take on a job of 5 years, you will be whipped.

The CHAIRMAN. How?

Mr. RALSTON. You will not get all the necessary experts in 6 months or a year or 18 months.

The CHAIRMAN. Is that so?

Mr. RALSTON. The mining and metallurgical schools are turning out a quarter of their normal capacity.

The CHAIRMAN. What is the cause of that? Is it not encouraging young men to go into science and engineering in the educational system?

Mr. RALSTON. There are a lot of causes. I do not think I know all of them. I have been to the atomic energy plants and seen a lot of the men who would normally study mining.

The CHAIRMAN. Of course, most of them want to get rich quick and they go down to Wall Street and try to make it there.

Mr. RALSTON. That is right. There are many other lines of technology that became much more popular than becoming mining engineers and metallurgists.

Senator MALONE. Mr. Chairman, I want to ask Mr. Ralston: Is not that a question of competitive pay in the Government?

Mr. RALSTON. It is.

Senator MALONE. If you put a program before this committee in a reasonable time—I would like to see it here in time for us to take some action in this session of Congress. I think that anything that does not come here until June is going to have a little rough sledding because people will get in a hurry. If you could get a program here on 2 or 3 or 4 of these processes in different areas and what it will cost on a definite 5-year program, if that is a reasonable length of time——

Mr. RALSTON. That is a minimum.

Senator MALONE. Then we will go into this matter of what you have to pay these people. Congress did not stand back on the Atomic Energy Commission.

Mr. RALSTON. Of course, a phrase is sometimes put in—without regard to civil service—but that is pretty difficult to have stick in the final bill.

Senator MALONE. Let us worry about that. You tell us what you will have to pay. We will start doing the worrying right away. How long do you think it would take to bring in an estimate of that kind?

Mr. RALSTON. I think that our regular budget people can get us some figures in 2 weeks.

The CHAIRMAN. It would not have to be a perfect program but something that would be a basis on which we could go to work.

Senator MALONE. Mr. Chairman, if it meets with your approval, I would be very glad to keep track of this thing and try to help bring it in.

The CHAIRMAN. Very well. I will delegate you to keep in touch with these experts.

Senator MALONE. I am so tired of getting into another committee or getting out some place, and they say, "We have no manganese, we have no tungsten, we have no this, we have no that," when they are really talking about the fact that you cannot compete with the 50-cent-a-day worker. That is what they are talking about. What I want to know is what this manganese is going to cost, and if we can find it out this year or next, of what the cost will be to lay it down the line in wartime with the wages we pay, then letting Congress determine whether they want to hire the low-cost labor or whether they want to hire the labor here. But we have you people to give us the estimate.

That is all, Mr. Chairman.

The CHAIRMAN. That is settled, and you gentlemen of the Bureau of Mines will try to work out some kind of suggestion to us on which we may be able to go forward.

Mr. RALSTON. We will pass this request along and try to get some quick action.

The CHAIRMAN. Thank you very much.

Senator BARRETT. Mr. Chairman, before you go to the next witness, may I ask a question or two?

The CHAIRMAN. Yes.

SOURCE OF MANGANESE IN TIME OF WAR

Senator BARRETT. Mr. Ralston, as I understand the testimony here this morning, the chief supplier at the present time is India, for manganese.

Mr. RALSTON. Yer, sir.

Senator BARRETT. Before the war it was Russia?

Mr. RALSTON. Yes, sir.

Senator BARRETT. Assuming that we would be unfortunate enough to have a third world war, we could not depend upon Russia or India for a supply of manganese.

Mr. RALSTON. Certainly not Russia. We would have a tough time picking up the cargoes and getting them through from India.

Senator BARRETT. Assuming that is the case, then our only avenues for supply would be Cuba and South America, is that not right?

Mr. RALSTON. Yes. The work of this committee up to date has shown that we probably can rely on South America. We can depend that far.

Senator BARRETT. Could we depend upon South American to supply our needs in that event?

Mr. RALSTON. They have two big new deposits there of almost astronomic size. One is a good one and one is not too bad.

Senator BARRETT. The one that is not too bad is better than what we have?

Mr. RALSTON. It is better than a lot we have.

Senator BARRETT. Could we depend upon that supply from South America within a matter of relatively short time if war should come?

Mr. RALSTON. Yes. The committee has already had the testimony to show that we can make ourselves self-sufficient within the hemisphe. We can make ourselves. We have not made ourselves, but we can.

Senator BARRETT. It can be available in a matter of very short time?

Mr. RALSTON. Yes, sir. That finding of the committee, I think, has not been challenged successfully.

Senator BARRETT. That is the way I understand the situation. The point I am getting at is this: If we were cut off from South America, what position would we be in, in the event we do not take some steps to develop our own resources here in this country? We would be sunk, would we not?

Mr. RALSTON. We would.

Senator BARRETT. Would our supply be limited to this 200,000 tons?

Mr. RALSTON. No. But we would have to organize ourselves for production which would take several years to accomplish.

Senator BARRETT. I know. I am not talking about several years. I am talking about a war. You cannot hold off a war for several years. You have to act immediately. What I am talking about is what you are going to do on May 12 or June 12 if war should happen today. Where are we going to be? That is the point I am after.

Mr. RALSTON. At the rate the wars are likely to be fought, we are going to be unfortunate.

Senator BARRETT. Could we take some steps—I assume Senator Malone has made that inquiry—that would make it possible for us to rely on our own low-grade supplies in this country in that contingency?

Mr. RALSTON. We can take steps, yes. They are not going to be palatable.

Senator BARRETT. Because of the cost?

Mr. RALSTON. Yes.

Senator BARRETT. Did I understand you to say that about four times the world price would be the incentive that would be needed to bring those ores?

Mr. RALSTON. Yes. Senator Malone made a calculation for us today that happens to come within that limit of four times the present cost.

Senator MALONE. You are talking about $2.30 a unit being enough of an incentive if we launch such a program as we are discussing in research?

Senator BARRETT. Yes. I understood Mr. Ralston to say that he had an overall figure of four times the present price which would be about $2.80. Is that what you have in mind?

Mr. RALSTON. I say I would put four as the limit, and he fell within the limit, so he is all right.

Senator BARRETT. You think it would be extremely dangerous so far as the security of this country is concerned unless we do develop

a sound policy here that will insure supply of manganese in all events for the protection of our country in that event?

Mr. RALSTON. That is a sound security measure.

Senator BARRETT. Thank you very much.

Senator MALONE. I might just say, Mr. Chairman, as long as the matter has come up, the Amapa deposit on the Amazon River was visited by George Holderer, and it took 11 days on the river to get there. It is one of the largest known in the hemisphere. How does it compare with the deposits in the world?

Mr. RALSTON. I believe if it is not the largest, it is one of the largest. Certainly for its tonnage, it is the richest.

The CHAIRMAN. Gentlemen, time is flying now, and we have Dr. Flemming with us, and I would like to have Dr. Flemming tell us what he thinks about the need for research in this field to develop the manganese for defense.

STATEMENT ON ELECTROLYTIC MANGANESE BY O. C. RALSTON, CHIEF METALLURGIST, BUREAU OF MINES

The present commercial production of electrolytic manganese was initiated in the Bureau of Mines under the leadership of Dr. R. S. Dean, and the primary patent on the process came from Stephen M. Shelton, who was assigned to the project about 1936. This patent was assigned to the Secretary of the Interior, and is available for free license to all United States citizens and domestic enterprises.

Any manganese ore that can be directly attacked by sulfuric acid or which can be heat-treated to convert the manganese to acid-soluble form, can be used in this process. The solution of manganese sulphate is purified of all elements that interfere with electrolytic deposition of manganese, ammonium sulphate is added to the solution to improve its conductivity, and the solution is then electrolyzed in a suitable electrolytic cell specially devised for the purpose. The deposit on steel cathodes is a thin sheet of pure metal with some dissolved hydrogen which is harmless, and sheets as thicks as one-eighth inch can be made. The hydrogen content makes the deposit brittle so that by a sharp blow most of the deposited manganese pops off the cathode without much hand work being required to loosen occasional areas of more tightly adherent deposit.

The great virtue of this metal is that it is practically free of carbon. It can be used in place of the usual ferromanganese in finishing common steel but has found its greatest use as a steel additive in the stainless steel industry where carbon is highly undesirable. Not only can this form of manganese be used in the normal finishing of stainless steel but larger additions can be made in order to make special alloys. Electrolytic manganese can be used as an alloy to displace part or all of the nickel needed in the usual stainless steel. During the nickel shortage of the past few years this property of the metal has been used considerably.

The Bureau of Mines undertook small-scale research on making electrolytic manganese for several years and experimented with its possible uses. Then a 1-ton-per-day pilot plant was erected at Boulder City, Nev., and the metal was made available free of charge to potential progressive users who might wish to experiment with it. The Rustless Steel Corp. of Baltimore was the first to risk use of a 30,000-pound carload in the manufacture of its products. Request for a second carload from this organization led to a recommendation that the company purchase it from Electromanganese Corp. of Knoxville, Tenn. where a 1-ton-per-day pilot plant had in the meantime been erected. Other stainless steel companies had become interested, and went through similar experiences. This created a market for the sole commercial producer who doubled his plant capacity to 2 tons daily, shortly doubled that output, and later doubled again to produce a total of 8 tons daily. By further internal improvement this 8-ton plant later produced 10 tons daily. About 2 years ago a second 10-ton-per-day unit was erected by Electromanganese Corp. About the same time a second commercial producer decided to enter the market. The Electrometallurgical Co., Division of Carbide & Carbon Co., arranged a license and built a plant at Marietta, Ohio, which has now been in operation for nearly a year.

Not only has electrolytic manganese competed with the specially low-carbon ferroalloy made by pyrometallurgical means, but during the Korean stringency it competed with nickel in stainless alloys as above mentioned. The pegged price of 35 cents per pound of nickel had to be met, and this came with enlargement of operations. With cancellation of the pegged price, nickel rose in price and competition of electrolytic manganese became much easier. There is also promise that the metal can compete with copper in making up certain brasses and bronzes, and it is calculated that when a single plant of 50 tons capacity per day can be justified its cost of production will drop well below the price of copper under normal conditions of demand. At the present price of copper the existing smaller manganese plants can compete. One of the alloys of electrolytic manganese is with copper itself and the alloy is a vibration- and sound-damping product. Only lead and rubber are now available for such use, and cannot even be considered for use in making less noisy gears. Airplane engines are too heavy to be thus mounted, but with a strong vibration-damping alloy it is obvious that unpleasant and destructive vibration would be minimized and less noise produced.

Electrolytic manganese is winning a niche for itself in the manganese economy. Whether its cost can be lowered to let it compete with the present commercial pyrometallurgical grades of ferromanganese is yet to be seen, but it has been thoroughly tested in finishing a wide variety of steels and is a desirable replacement from the technical standpoint. It can be made from low-grade ores but at a higher cost than from high-grade ores. A small amount of domestic ore contains cobalt as an added value that can be recovered before electrolysis of the manganese, and that would add to the economy of the process. Unfortunately the supply of such known ore is all too small. Some manganese ores also carry small amounts of lead and zinc, such as the Three Kids and Pioche ores in Nevada. The lead and zinc must be removed before good electrolytic manganese can be made. Silver is also found occasionally with manganese, and would remain in the residue of tailing of an electrolytic manganese plant. Little has been done to assess the commercial possibility of getting added values from such ores. The producers have had enough complications to deal with to put a new metal onto the market without inviting more trouble in trying to recover possible minor additional values.

STATEMENT OF DR. ARTHUR S. FLEMMING, DIRECTOR, OFFICE OF DEFENSE MOBILIZATION

Dr. FLEMMING. Mr. Chairman, Senators, as far as I am concerned, my basic approach to this total area is that I feel we should do everything we possibly can to develop our domestic mobilization base, both in manganese and in connection with other metals and materials. Consequently, I am very much in favor of the Government making a considerable investment in research designed to see if we can develop a process that will lick this problem that you and Senator Malone have indicated has been with the country for a considerable period of time.

POSSIBILITY OF USING LOW GRADE MANGANESE DEPOSITS

The CHAIRMAN. You think it is possible for us to use these low-grade manganese deposits we have here in the United States?

Dr. FLEMMING. That is right. We are hoping that we can get to the place where they can be developed in such a way as to provide them with a position where they can compete successfully from the price point of view and find a real market in this country. Anything along that line is all to the good.

Senator MALONE. You do not think you are ever going to compete not only in metals but hundreds of other things with the great disparity in wages? I was not talking about competing with 50-cent wages and $2 or $3. I was talking about living like Americans live and that difference that we can pay.

Dr. FLEMMING. That carries over into another basic fundamental problem which you indicated is now before the Senate.

Senator MALONE. That is right.

Dr. FLEMMING. As far as the research side of it is concerned, I am personally all in favor of it. I think anything that we can do along that line makes good sense. I certainly think it is a fine thing that you have asked the Bureau of Mines to present the kind of program that you have.

The CHAIRMAN. It is absolutely necessary that we should follow that course.

LONG-TERM STOCKPILE OBJECTIVES

Dr. FLEMMING. I think that is the only way in which we can be sure of the fact that we are on a solid foundation. Mr. Chairman, Senator Malone and other members of the committee appreciate the fact that we do have a stockpiling program that is designed to improve our position. I think the members of the committee know that we have what we refer to as a minimum stockpile objective and long-term stockpile objective.

In analyzing supply, in setting the minimum stockpile objectives, supplies from foreign sources have been discounted in accordance with strategic advice given by the Joint Chiefs of Staff and also from the Department of State. But to make sure of the fact that we are in a good solid position, the President, a little over a year ago, directed us to set long-term stockpile objectives. In establishing those objectives, he directed us to discount foreign sources of supply 100 percent except for Canada, Mexico, and a few countries around the Caribbean. It seems to me that is a good sound policy and one that is designed to put us in a more secure position.

Even with our long-term stockpile objectives, I have the feeling in this area and other areas that everything we can do to strengthen our domestic base is all to the good. Certainly a research program of this kind, I think, is helpful. In other words, I have been told that there has been enough progress made with research programs to indicate that it would make good sense for us to go further than we have up to the present time.

WENDEN DEPOT QUOTA

The CHAIRMAN. Senator Goldwater is anxious to get some information here with reference to the Wenden depot in Arizona. The Wenden depot, as I understand, exhausted its 6 million recoverable long-ton unit quota. Orders have been given to close down April 30, 1955. A number of bills are pending to continue the purchase programs until 1963. Would it not be cheaper to assign new units to the Wenden quota rather than to go to the expense of opening and closing it until it is seen if one of the bills will pass? Most of the Wenden area shippers cannot afford to ship to Deming. Even if they did, they will be absorbing part of the Deming quota. The Deming facilities will have to be expanded at the same cost to take additional ore. About 50 mines and 1,000 miners are involved.

Have you any comments on that, Dr. Flemming?

Dr. FLEMMING. Senator Murray, under existing law that presents us a rather difficult problem. That statement that you have made, of course, is correct as far as the 6 million recoverable units are concerned. We revised the interpretation of the program in December in order to make it 6 million recoverable units, and it is my understanding that they will reach that goal sometime during the month of April.

Under the act that we work under, the use of the funds that the Congress has made available must be based on findings that the material is needed for defense. Of course, there is no difficulty there with respect to the strategic importance of manganese. But additional purchases must also be based on a finding that increased supplies are necessary and cannot be obtained on more favorable terms.

As you can appreciate, under present conditions, it would be difficult for us to go ahead and add to the quota of this particular depot.

Senator MALONE. Where does that include?

Dr. FLEMMING. Any place.

Senator MALONE. In the world?

Dr. FLEMMING. That is right. That is the wording of the present Defense Production Act. I have here a strictly legal problem that confronts me in terms of responding to that kind of request. It is the kind of thing that the Congress may want to take a look at when the Defense Production Act comes up for renewal, which it will in the next few weeks. But at the moment, that is the situation I am up against.

The CHAIRMAN. Are there any other questions?

Senator MALONE. Dr. Flemming, do you mean that the 6 million units is all that you could buy and give a preference to domestic users?

Dr. FLEMMING. That is as far as we can go under the Defense Production Act right now.

Senator MALONE. Does this 6 million include just what is in that stockpile out there?

Dr. FLEMMING. That is the quota that was assigned to this particular depot. Of course, there are the depots at Deming, N. Mex., and Butte-Philipsburg, Mont. Quotas for these depots were also 6 million units each.

Senator MALONE. How much have they delivered?

Dr. FLEMMING. I think it is 2½ million.

Mr. CLEMMER. Mr. Chairman, I am Bruce Clemmer, Chief of the Minerals Technology Division of the United States Bureau of Mines, Salt Lake City, Utah. As chief of the Technology Division, we have been acting as technical advisers to GSA in the operation of their depots. We have assembled some data here. It is along the line that Dr. Flemming has mentioned.

Based upon our present rates, average rates of receipts at the depot, it now looks as if the Wenden depot will obtain its 6 million recoverable units on or about May 31. That is a more recent figure than perhaps you have, Dr. Flemming.

Dr. FLEMMING. My understanding was that they would reach it by April.

The CHAIRMAN. It says orders have been given to close it down.

Mr. CLEMMER. There has been a curtailment of shipments into the Wenden depot in the last month or 6 weeks.

Senator MALONE. It was in anticipation of the shutdown, perhaps.

Mr. CLEMMER. Yes, sir.

Dr. FLEMMING. May I ask: Can we assume that the orders to shut down on April 30 will be changed and moved up to May 31?

Mr. CLEMMER. I would assume so. They normally give a shipper 2 weeks' notice of closing of a depot. If you are interested, I also have the later figures on the Deming, N. Mex., depot.

Senator MALONE. When do you estimate they would reach their limit?

Mr. CLEMMER. The Deming 6 million recoverable units, according to our estimate, and this is an extrapolation of facts, at present we are receiving 1,700 long dry tons a week, and as it says, about 25 percent manganese.

We further assume that on closing of Wenden, if that does materialize, that we will receive an additional thousand tons a week from Arizona producers. That would mean a total of 2,700 long dry ton units per week and using that as an estimate, we believe that Deming probably will close down in September of 1956. That is being rather lenient, we believe.

Senator MALONE. It seems to me, Mr. Chairman, that there would be an area to explore there, because certainly before that time, Congress is going to act on this matter. In order to show any understanding of the problem at all, we now know where most of the manganese is likely to come from. We know the sources. I myself have an idea we will be a little more liberal with the domestic production.

Dr. FLEMMING. I do not know, Senator Malone, whether your questioning was leading up to this; that is, whether or not in effect you can combine these quotas.

Senator MALONE. Change your assignment out there.

Dr. FLEMMING. The thing we have to keep in mind is that when the program was started a number of years ago, there was a formal notice of it put in the Federal Register, and there is a commitment on the part of the Government to the effect that it will take 6 million units in the Deming depot and also 6 million units in the Butte and Philipsburg.

Of course, I think we have reason to believe that some people have developed their plans and operations on the basis of that commitment on the part of the Government. So, consequently, I do not think we can reduce directly or indirectly the quota at Deming and the quota at Butte-Philipsburg in order to allow more to go into the Wenden depot.

Senator MALONE. Let me ask you this. It does not matter where it comes from. You accept it in the New Mexico plant. It does not have to be produced in New Mexico?

Dr. FLEMMING. That is right. It can be shipped in, as I understand.

Senator MALONE. Then the only thing you do is to make it cost more. They will ship to a different stockpile.

Dr. FLEMMING. That is correct.

The CHAIRMAN. I was going to point out that we have pending in the Senate here several bills now. One bill is Senate bill 920 on manganese to extend the period of the stockpiling program.

There are two other bills, S. 922 and S. 1543, which extend the period for all minerals.

Mr. ADLERMAN. They are before the committee right now.

The CHAIRMAN. You are in favor of having those bills passed?

Senator MALONE. I think I would be in favor of us studying them right away to see where we are headed.

Dr. FLEMMING. Mr. Chairman, taking the one on manganese, if this committee could hold an executive session on that—at least part of the session could be executive—we could put before you the complete picture as far as the stockpiling situation is concerned, and the committee could then use that as a basis for determining just what action it desires to take.

Senator MALONE. I think we should do that at the earliest opportunity.

Dr. FLEMMING. We would be very happy to appear and present all the information that is available to us at that time.

The CHAIRMAN. We will do that.

Thank you, Dr. Flemming.

Dr. FLEMMING. Thank you, Mr. Chairman.

The CHAIRMAN. It is 20 minutes after 12. Do we want to continue any further? Does any witness wish to make a statement and want to get away, or shall we go over until 2 o'clock?

We will meet again at 2 o'clock.

(Whereupon, at 12:20 p. m., the subcommittee recessed, to reconvene at 2 p. m.)

AFTERNOON SESSION

The CHAIRMAN. The committee will come to order.

The first witness this afternoon is Mr. Felix Wormser, Assistant Secretary. Is there anybody with you?

Mr. WORMSER. There are representatives of the Bureau of Mines.

The CHAIRMAN. Do you want them to come up here?

Mr. WORMSER. I believe I will call on them if necessary, Senator, to answer your questions.

STATEMENT OF FELIX WORMSER, ASSISTANT SECRETARY, DEPARTMENT OF THE INTERIOR

The CHAIRMAN. Have you a prepared statement with you?

Mr. WORMSER. No, sir; I am just here to offer my assistance in any way possible, Senator, to your committee.

The CHAIRMAN. The witnesses from this morning were talking about research operations in the Bureau of Mines, the importance and necessity of these research studies. Have you some observations to make on that point?

NEED OF RESEARCH IN MINERALS

Mr. WORMSER. I agree thoroughly with the need of research in the mineral field, Senator. I am glad to hear that they did make declarations to that effect. I think it is particularly necessary in the mineral field because, as you know, our resources are getting leaner and leaner as time goes on. We have to know how to handle them efficiently and for the benefit of the people.

The CHAIRMAN. In order to utilize these lower grade deposits, you have to have some considerable research in order to find how to beneficiate them, concentrate them. You have gone into that to some extent, I suppose? You have made some study of that?

Mr. WORMSER. As a matter of fact, since the Bureau of Mines has been established, it has conducted research in that field very extensively, as you know. As our techniques have improved, it, as well as industry, has contributed immeasurably to the handling of materials that a few years ago would not have been thought of.

The CHAIRMAN. Has the Bureau been doing anything in connection with the studies and research on the titanium?

Mr. WORMSER. Yes, sir. As a matter of fact, I think, in modesty, I can say it was the Bureau's work that built up the commercial means of producing sponge titanium.

The CHAIRMAN. In other words, titanium now can be used in the airplanes where great heat resistance is required. Has that been well established or is there some question about it? Is there any question, any serious question, as to the effect that titanium will not be used?

Mr. WORMSER. Not to my knowledge, Senator. In fact, my impression is distinctly to the contrary, that titanium serves a field of vast importance in the airplane industry.

The CHAIRMAN. Is there any question about it in the minds of some experts?

Mr. WORMSER. The only question I have heard, Senator, is the possibility of, as the technique is developed, some imperfections in perhaps alloying or some application of the metal itself. There are bugs, as there always are in the development of any new industry as to the application of any new metal. It takes years to iron those out. So you may anticipate some trouble in the application of titanium, just as in other metals that found their way into commerce.

The CHAIRMAN. Of course titanium is a very expensive metal, very costly.

Mr. WORMSER. It is costly, sir, and especially when it is converted to the final form: That is, sheet, pipe, or extruded products or whatnot. But it seems to be going down gradually. There was a decline in price just a few weeks ago, and that helps.

PROGRESS IN RESEARCH ON MANGANESE

The CHAIRMAN. What is the progress with reference to manganese? What progress has been made in the research and studies on manganese to make it possible for this country to survive with manganese in such quantities as to satisfy the demands of our country in time of war?

Mr. WORMSER. I know the Bureau, sir, has devoted a lot of its time, energy and funds to that very problem, of utilizing our own resources to produce the manganese required by industry and for defense purposes. I would suggest, if you have not done so, sir, you inquire of the specialists of the Bureau who actually have the responsibility of conducting those programs to give you the details. I am sure they would be delighted to do so.

The CHAIRMAN. We might do that. What are their names?

Mr. WORMSER. I think Mr. Melcher and Mr. Zinner.

The CHAIRMAN. They were here this morning.

Mr. WORMSER. I did not know they testified this morning.

The CHAIRMAN. Do you have any questions, Senator Malone?

Senator MALONE. I was interested in what you said about titanium, referring to that for just a moment. Have you had any indications that there has been any slack-up in the application through the Defense Department?

The CHAIRMAN. Do you mean with reference to titanium?

Senator MALONE. Yes.

Mr. WORMSER. I do not know exactly, Senator, what the Defense Department's present position is.

Senator MALONE. Before the crackdown on information coming out of National Defense, a very prominent representative of that Department said in a meeting that they were not going to use it.

The CHAIRMAN. Not going to use titanium?

Senator MALONE. Yes.

We had several hearings on titanium, because it seemed that it met a strength-weight ratio, together with heat resistance, that no other metal met. Each time it looked as though they were going to increase the quota, nothing happened. I think it was 2 years ago that the Defense Department set the figure at 36,000 tons annually that they needed. I am not aware right now exactly where we are, but we are somewhere having let contracts for twenty or twenty-two thousand tons and we are making actually about five or six thousand. But there is no real effort being made, apparently, to boost the production.

Mr. WORMSER. Are you speaking of sponge, sir, or the finished product?

Senator MALONE. All of it.

Mr. WORMSER. I think you will find, sir, that the sponge program is well advanced.

Senator MALONE. I would not say so, because a year and a half ago it was very evident what we would need if we could get it, and that was about 150,000 tons a year. The National Defense organization has never changed their 36,000 tons.

Mr. WORMSER. I thought you referred to whether or not the sponge program was advanced, and I know that contemplates the steady growth.

Senator MALONE. I would not say it is advancing very fast, if it is an important metal. You are making 6,000 tons and you have been at it for about 4 years.

Mr. WORMSER. If my understanding is correct, we are producing more than is actually being used and we are stockpiling it, Senator.

Senator MALONE. That is what is bothering me at the moment.

Mr. WORMSER. That has no relation to the production of the sponge. That has reference to the application of the tons.

Senator MALONE. It has increased maybe 2,000 tons in 2 years, 1½ years.

Mr. WORMSER. Regardless of how it has advanced, Senator, the fact remains that we have more sponge than we can utilize today.

Senator MALONE. That is just what is bothering me. I am about to make a suggestion to the distinguished chairman of our committee that we look into that. There is something the matter with it. You do not have any idea what it is?

Mr. WORMSER. My function, as you know, Senator, has been in the production of the raw material, to make sure that has come out in the volume necessary to serve the Defense Department and Commerce.

Senator MALONE. This is the latest information that I really have on it, that it would take or probably require a year to two years to perfect the alloys. It takes two years to build a plant. Is that not about right, 1½ to 2 years?

Senator MALONE. Therefore, they want to wait until they perfect the alloys, and then let contracts for construction, which means 4 years. None of it makes any sense, but that is the way it is. You say that there is more titanium now than they are using, and you are exactly right. Have you looked into it at all as to what is holding it up?

Mr. WORMSER. Only broadly, Senator. As I have indicated a few minutes ago to the chairman, it is my impression that there are certain alloy problems that are troublesome in designing and producing the ultimate military equipment. So I would refer you to other authorities on that score, because it is a little out of my field.

Senator MALONE. I think that is what we should do. But did you make any inquiries as to how long it would take to work out these alloys? That is, the proper alloys?

Mr. WORMSER. No, sir, I have not.

Senator MALONE. Our information was about 1 year to 2 years, and that they are waiting until they get a perfect alloy before they build the plants to make the amount they need. Of course that would not make any sense to me, but I pass it now. I think it is a very important thing, and I think this committee should start in on it again, and pin it on whoever is responsible. As you know I have a lot of confidence in Dr. Ralston and his associates. This morning we asked him to make an estimate of the cost over a period of time, say 5 years, to carry along the necessary research on two or more processing methods of securing manganese from the Cuyuna Range, and from the slag waste, that ordinarily would have been waste manganese from the steel mills.

It would be appreciated very much if that could be done. You see, we get such conflicting information that it is a little bit like titanium.

IMPORTANCE OF MANGANESE AS STRATEGIC MATERIAL

You cannot make a pound of steel without manganese, and still we do not produce any in the United States. They say we cannot, that we have to bring it from India. You cannot get it from India in wartime. Of course we do fall into those ruts. This estimate that we have asked for—and Mr. Chairman, Mr. Wormser is in charge of the whole thing—if you would do that, where we have asked, for the record, how much money it would take, and the time involved, we would appreciate it.

Mr. WORMSER. That is rather important, the time element, because so many research programs are started and then they are terminated. Frankly, it affects the quality of the personnel that you can retain for a research program. If they see it is only going to extend for a year and then be lopped off, they are not so much attracted to it. But if they have some assurance that a research program will go until some results are achieved, I think there is a better chance of getting the proper personnel and also achieving your objective in a much shorter time than would ordinarily be the case.

Senator MALONE. There is one other thing, Mr. Chairman. Mr. Wormser is exactly right. His Bureau worked out or perfected a

process for titanium, but we found that some of the best men in the country, in research, in the Bureau of Mines laboratory at Boulder City, were very much underpaid by comparison to what they could get in private work, and even in other research programs. They were losing. We asked that question, too. Mr. Wormser, you would have to keep your research personnel.

Mr. WORMSER. I am delighted to hear you say that. It is true that these men are devoted public servants and spend years in the Bureau tackling very interesting, fascinating problems. Perhaps that is some reward. They have the thrill of making a discovery or adding to our knowledge. But unless there is some assurance that they can carry on that for some period of time, it is rather difficult to attract them and keep them on the job.

Senator MALONE. I believe this exists on titanium, too. There are many divergent views that have grown up because of divergent interests. For 37 years, since the First World War, we have wavered in peace and war on manganese. We quit investigating it. I think we will find they are doing the same thing in sidetracking titanium. There is some other interest. That foreign production of American firms, unfortunately, has done us a lot of harm in manganese, because you get it at maybe 6 or 7 cents a unit, with $2 labor or $3 labor, with 50-cent labor in Africa. Here we want the boys to live well, so it is $12 to $15 a day. What most people are talking about is the difference in the wages and standards of living, and they want to get it from the cheap-labor countries. I think that is where it finally comes down, and I believe it pins down to just that point. We can get a set-up started here and know what you can do in the United States.

I think in another committee we are getting pretty close to the point on this business of the difference in the wages and standards of living, and some continuity or assurance to the American investor and workingman that he will keep his job. We will then get further.

Thank you.

The CHAIRMAN. Thank you, Mr. Wormser.

Mr. WORMSER. Thank you, Mr. Chairman, and Senator Malone.

The CHAIRMAN. The next witness is Mr. Royster.

STATEMENT OF PERCY ROYSTER, METALLURGIST, BUREAU OF MINES, DEPARTMENT OF THE INTERIOR

The CHAIRMAN. You had some connection with the mangaslag process?

Mr. ROYSTER. Yes. I was assigned by the Secretary of the Interior on administrative leave without pay on the 1st of January 1953, to design and carry on experiments on the mangaslag process, being on loan to Mangaslag, Inc. I returned to the Bureau on the 1st of January this year.

The CHAIRMAN. What was done on the Mangaslag job? How much money was spent?

REPORT ON MANGASLAG RESEARCH PROJECT

Mr. ROYSTER. Approximately $2 million. I do not have the exact figures. The original contract was for $1,250,000, with 80 percent from General Services and 20 percent from private capital. This

was increased by $400,000, and then private industry continued after the 1st of September, when our funds were expended, up to the 1st of January. I have not been told how much was spent there, but I think the total came to about $2 million.

The CHAIRMAN. Why was the plant shut down?

Mr. ROYSTER. Because there was no more money.

The CHAIRMAN. You could not get the appropriations necessary to carry it out?

Mr. ROYSTER. That is correct. Under the terms of the contract, the equipment and everything there reverted to General Services Administration who now have it on their hands.

The CHAIRMAN. So there is nothing being done now with reference to that process?

Mr. ROYSTER. Nothing so far as I know. GSA will probably know what they plan to do.

The CHAIRMAN. Do you think it should be resumed?

Mr. ROYSTER. Yes. Technically I would say yes, without qualification. We did not get more than what you might call a few preliminary runs on it. Actually, about 30 days was the total operation from which data were taken which would be of value.

The CHAIRMAN. If it was successfully worked out, it would be a great advantage?

Mr. ROYSTER. If it worked out as well as you could calculate in advance—and I have never known anything to do that—it would take care of about 61 percent of our total requirements for manganese at any level of capacity of our steel plants. When the plants were working at half capacity, the tonnage of the slag would drop to one-half, and the supply would remain at 61 percent, leaving 39 percent of our requirements to be taken care of from other sources.

The CHAIRMAN. Have you any other observations to make with reference to this matter?

Mr. ROYSTER. The present steel making capacity of the country is 124 million annual net tons of ingots, and the plants produce about 18 million tons of slag per year. Approximately 8 million annual tons of slag is recharged in the blast furnaces in order to recover the contained manganese, lime, and iron; something like 10 million tons are discarded as waste.

That would be our potential raw material. It is available within a very few miles of the consumption of the ferromanganese. For example, the Chicago district, where the Gary, South Chicago, and Indiana Harbor plants are located, can produce 26 percent of our ingot capacity. A plant to process waste slag and return ferromanganese to the plants from which it came would not involve more than 30 or 40 miles of transportation. The next important consideration is the fact that the slag is worth nothing to start with. The cost of processing is impossible to estimate unless you specify what year you mean. I can tell you what it would have cost 10 years ago, but what it will cost next year or five years from now will depend largely on the cost of coke and labor. If we assume that coke, on the average, in the steel centers of America would cost $20 a ton and at last year's wage scale, the cost of making an acceptable synthetic manganese ore would be about $3 a gross ton unit. This figure does not take credit for any byproduct values. If all the available waste slag was processed you would make approximately a million net tons of a

synthetic ore running 59.5 percent managanese, with the iron down to only 1 or 2 percent.

That is a richer ore than you could find anywhere, and it could be blended with a very large amount of high phosphorus, high iron, lower grade ores and still make ferromanganese of acceptable grade.

The iron in the waste slag would run about 2,000,000 tons a year. When I said $3 a gross ton unit, I was assuming you threw that iron away. The proposal is to dephosphorize the iron and cast it into pigmolds for open-hearth feed stock. For that purpose, there would be a credit of around a dollar and a half a unit of manganese depending on the price of scrap.

In the last 2 years, heavy melting scrap has varied from $29 to $42 a ton. What it will be next year or what it will be during wartime, I wouldn't have any way of knowing. It would be a very preferred scrap, lower in impurities than anything that is elsewhere available. If you set a reasonable figure for its byproduct value, it will bring the cost of a gross ton unit down to around something between $1.50 and $1.90 a ton. Those figures are accurately calculated from very inaccurate figures.

The CHAIRMAN. Senator Malone, have you any questions?

Senator MALONE. What you say is very interesting, about the byproduct. Is there any other byproduct except scrap iron?

Mr. ROYSTER. Yes. There would be a phosphate fertilizer that would probably give a 60 cents per gross ton unit credit for fertilizer. The phosphate material would correspond to what abroad is called Thomas slag, or a basic Bessemer slag. That is the term used in Europe. It is used abroad for fertilizer. It would run about 34 percent phosphate and would be worth around 90 cents a net ton unit. Say 90 dollars a ton of P_2O_5 in the steel regions of Ohio, Indiana, Illinois, and Pennsylvania.

Senator MALONE. You say the original manganese, all loaded on the cost of the manganese, would be about $3 a unit?

Mr. ROYSTER. If you did not take credit for iron and phosphorus; that is right.

Senator MALONE. If you take credit for scrap steel, what would that leave the unit cost of the manganese?

Mr. ROYSTER. That will depend on whether I take the value of heavy melting scrap at $29 or $42.

Senator MALONE. Take it at $30, say.

Mr. ROYSTER. It would be a steel scrap which would analyze not more than five-thousandths of 1 percent each of phosphorus, sulphur, carbon, silicon, and manganese. It would be very high purity scrap, and would be cast molten into pigmolds. Since rails, 2 feet and under, have always carried from an $8 to $12 premium over heavy melting scrap, this scrap would take at least that high a premium on account of its shape, size and uniformity. That would bring the cost of a gross ton unit manganese in the synthetic ore to about $1.40.

Senator MALONE. You are talking now about 22 pounds of manganese?

Mr. ROYSTER. Yes, that is right, 22.4 pounds.

Senator MALONE. At $1.40 for 22 pounds?

Mr. ROYSTER. That is correct.

Senator MALONE. We are paying $2.30 for it now, are we not?

Mr. ROYSTER. I understood we were paying 80 cents a ton for it now. I do not know whether you are comparing this with the imported or domestic ore.

Senator MALONE. In the special bill we passed out of this committee, it is around 70 cents on the world market and around $2.30 here.

Mr. ROYSTER. That is right.

Senator MALONE. Are there any other byproducts that you can think of?

Mr. ROYSTER. No. The waste slag is simply the impurities which were taken out of the steel. It is like the dirty dishwater left after you wash the dishes. We have to separate the manganese, phosphorous and iron from each other before we make any one of them useful.

Senator MALONE. That is what manganese does, it cleanses the steel.

Mr. ROYSTER. That is right; and the dirt goes out in the slag, which they throw away. You pick it up and take it back and use it over again.

TIME NEEDED TO PERFECT MANGANESE PROCESS

Senator MALONE. You heard the discussion this morning. What I was trying to arrive at, for the benefit of the committee, was the time element involved to perfect either this process or get it to the point where it is practicable. What would you say about the time element if you had the money and could just get your crew together and go to work on it?

Mr. ROYSTER. The question of money and the question of time would depend on whether private industry or the Government did the job. I worked for both.

Senator MALONE. We only deal with the Government here, but they are generally given leeway to make subcontracts or make some kind of combination operation.

Mr. ROYSTER. I was going to say that I have run experimental blast furnaces since 1919. I think the last furnace plant I built and operated was the 30th. I have done experimental furnace research for the Department of Agriculture, the Bureau of Mines, the Tennessee Valley Authority, and for steel companies. I would say you would need 18 months to design and put up the experimental equipment. You should allow yourself at least 2 years for experimental operation.

Senator MALONE. That would be 3 years and a half?

Mr. ROYSTER. 3½ years total time.

Senator MALONE. In 3½ years you should be in a position to design a mill, then, or a production outfit?

Mr. ROYSTER. We should be in a position to solve the technical engineering problems necessary for designing a commercial plant.

Senator MALONE. Then what would be the time element in designing a plant and putting it up?

Mr. ROYSTER. We would probably be wise to wait until the end of the pilot plant operation before we did much designing, although perhaps half of it could be done in advance.

Senator MALONE. I am figuring we have the 3 years in advance. Of course the routine stuff could be ready. But I am asking you because you are the expert.

Mr. ROYSTER. I will confess to being an expert in the design and operation of experimental furnaces but I do not have experience in the construction of commercial-scale furnaces.

Senator MALONE. If we had an expert in this matter, we would have it already done. You are looking into the future. Take the end of the 3½ years, having everything done in the way of routine matters. How long would it take then, do you think, to design a plant and put it up to go into operation of some substantial tonnage?

Mr. ROYSTER. I should say it should be built in a year and a half. I am estimating this on the basis of a number of war plants which were put up in the Second World War.

Senator MALONE. That would include the time of design?

Mr. ROYSTER. Design and construction. Delivery of the equipment would be one of the longest delays encountered.

Senator MALONE. You found, too, that if the Government really wanted to give it some help, there wouldn't be very much delay in that part of it. You heard us talking about 5 years this morning. That 5 years looks to be, from your standpoint, as a time in which you ought to be in production?

Mr. ROYSTER. That is correct. Remember, to produce this tonnage, and to smelt 9 to 10 million tons of waste slag, would require 15 very large blast furnaces in 5 different locations. Waste slag is too low grade to be transported more than a few miles.

Senator MALONE. Of course, you would build one plant first. Then when you got into operation, you would learn some more things and then build the rest of them.

Mr. ROYSTER. That is right. Your plants would be in five locations, with the largest in Chicago and Pittsburgh, with Youngstown third.

Senator MALONE. What would be the largest capacity in Chicago?

Mr. ROYSTER. About 1,800 tons of spiegeleisen per day, in, say, the Chicago plant, which would treat about 26 percent of the available waste slag.

Senator MALONE. How much is that a year?

Mr. ROYSTER. Almost 700,000 tons.

Senator MALONE. Well, you are getting into the money there; are you not?

Mr. ROYSTER. That would require 2 blast furnaces for about 95,000 cubic foot of wind a minute, furnaces which would produce about 1,500 tons of pig iron a day.

Senator MALONE. What is the annual consumption of manganese?

Mr. ROYSTER. In terms of ore, a little over 2 million annual tons at capacity operation.

Senator MALONE. This capacity, this 700,000 tons, do you mean that is of the slag you are running through?

Mr. ROYSTER. No; that is the amount of spiegeleisen which is the metallic product resulting from smelting waste slag.

Senator MALONE. What percentage is that of manganese?

Mr. ROYSTER. The metal would run about 22 percent of manganese. The original waste slag would average about 7½ percent manganese.

Senator MALONE. How many mills would you say it would take?

Mr. ROYSTER. Of blast furnace units, about 15.

Senator MALONE. In different locations?

Mr. ROYSTER. Five locations would be logical.

Senator MALONE. What would be the capacity, then, of those 15?

Mr. ROYSTER. The one I quoted to you was for the Chicago plant, which I mentioned just as an illustration, and that is 26 percent of the total slag to be smelted. The Pittsburgh region would have about 23 percent, and Youngstown's and Buffalo would be about the same at 18, and then an eastern plant would run about 15.

Senator MALONE. The total production, annually, would be about what?

Mr. ROYSTER. Annual production would be just under 3 million tons of 22 percent metal.

Senator MALONE. Now we are getting into the business. The costs, then, in your judgment, would be somewhere around a dollar and a quarter or not more than a dollar and a half?

Mr. ROYSTER. I would not care to put it under a dollar and a half. That, you understand, will depend upon the cost of labor, the cost of the coke, and the cost of transportation. I have a way of telling what it is today but not what it is going to be tomorrow.

Senator MALONE. But on the basis of today, this is it?

Mr. ROYSTER. Yes.

Senator MALONE. Is there any doubt in your mind that if given the go-ahead and the money to experiment with, and carry this program through, that it would be successful?

Mr. ROYSTER. Let me put it this way. I am sure you would not do any better than the figures I have just given you. It is my considered judgment that that is what you would shoot for. That would be the star you would hitch your wagon to.

Senator MALONE. Maybe I asked the question badly. What I want to know is would there be any doubt, and would there be any element of doubt, of the success of the program?

Mr. ROYSTER. Technically no, none whatever.

Senator MALONE. That is the way I should have asked it.

Mr. ROYSTER. The process has been carried through all of its steps. The Bureau of Mines has done this on the scale of about 1 to 2 tons of spiegeleisen a day, in a small furnace something like 19 inches in diameter.

Senator MALONE. Whether it costs $1.30 or $1.40 or $1.20, technically you can do it?

Mr. ROYSTER. Yes. I would say with credits for iron and phosphate byproducts, it certainly would not cost more than $2 per gross ton unit, and the manganese would be in the form of a very rich ore. It would be a uniform material, and its analysis would be under accurate control.

Senator MALONE. What percentage of your annual consumption of manganese would that be, considering, of course, today's use?

Mr. ROYSTER. That would be 61 percent at any capacity. The current production of slag, if smelted currently and returned to the plants, would furnish 61 percent of the manganese requirements for our total ingot capacity. Let me point out that a considerable tonnage of waste slag cannot be used due to the fact that many iron ores used in steelmaking do not have very much manganese in them. You would have to leave out the slags from Alabama, California, Utah, and Colorado. The iron ores used are too low in manganese, so that the waste slags are too low in manganese to be treated or they are too far removed geographically to be practicable. The figures I gave

you of 10 million tons are those which could be transported to a smelting plant with reasonable costs.

Senator MALONE. That would be 61 percent of the annual use?

Mr. ROYSTER. That is right.

Senator MALONE. What would that leave?

Mr. ROYSTER. That would leave 39 percent.

Senator MALONE. I mean in tonnage.

Mr. ROYSTER. Well, we need 2 million tons of high grade ore at full capacity. Thirty-nine percent of that would be 780,000 tons of imported 48 percent ore.

Senator MALONE. Well, whether you imported it or got it from Montana or someplace else, or Minnesota?

Mr. ROYSTER. I mean the equivalent of the standard dry basis ore.

Senator MALONE. We are producing 200,000 tons now of new manganese?

Mr. ROYSTER. Yes. Let me point out that the manganese used in a steel plant is in the form of metal. You do not use manganese ore in making steel. In converting manganese ore into ferromanganese, there is about an 84-percent recovery of the manganese. In other words, we lose 320,000 tons of high-grade ore per year in the present-day process of converting it into ferromanganese.

Senator MALONE. But what I am trying to get at is this. We have around 800,000 tons of manganese ore that we have to secure elsewhere.

Mr. ROYSTER. If you want to be 100-percent secure, yes.

Senator MALONE. We have fooled around with this question now, we and our predecessors, for 37 years. I think it is time we pinned its ears back, do you not?

Mr. ROYSTER. I like to have 100 percent of what my needs are. At home, I like to be able to pay all my bills, not just 61 cents on the dollar.

Senator MALONE. We may not be able to get the 100 percent.

Mr. ROYSTER. I have run into that difficulty at home myself.

Senator MALONE. Maybe we should not have to get 100 percent. But if we shoot for 100 percent, from all of the information we have we can get it from other places in the western hemisphere. Even in an emergency they will be available to us. But this 61 percent is a tremendous thing.

Mr. ROYSTER. Let me point out you get it from one process. You only have a single research problem which, if solved, may bring us in 61 percent of our requirements.

Senator MALONE. You have the Cuyuna Range. Do you know anything about that?

Mr. ROYSTER. At the present time, I am out of touch. I have been away from the Bureau of Mines for 2 years.

Senator MALONE. Someone else knows about that?

Mr. ROYSTER. Yes.

Senator MALONE. I think, Mr. Chairman, you are making good progress there.

POSSIBLE SHORTAGE OF COKE IN AN EMERGENCY

Mr. ROYSTER. Let me add something that you might have overlooked. This cost of $3 a unit is largely the cost of coke required to smelt the original low-grade material. The entire process would re-

quire about 5 million tons of coke per year. If you assume we will have an emergency, the present steel industry will have no surplus of coke available. It would take about 900 coke ovens, as best designed, to supply that coke. The time and money required to build the coke ovens would exceed the time and money to build the furnace plant.

Senator MALONE. One of the reasons we are trying to pin this down is so that we will think of all of these things. I personally know where there is plenty of coking coal.

Mr. ROYSTER. We have plenty of coking coal but no coke ovens to turn it into coke.

Senator MALONE. We know how to make coke, do we not?

Mr. ROYSTER. Yes.

Senator MALONE. Now, we have peace, so we could build coke ovens now, could we not?

Mr. ROYSTER. Yes.

Senator MALONE. All we would have to do is to pay for them.

Mr. ROYSTER. In the figures I have from the man who handled coke oven construction for War Production Board in the Second World War, today we can build about 1,200 ovens a year. We already have about 18,000 coke ovens and have to rebuild about 6 or 7 hundred of these a year to keep even.

Senator MALONE. That means all he could build now. But if he could get the money, he could build more, could he not?

Mr. ROYSTER. Yes.

Senator MALONE. What I am trying to do is not to get mixed up in a bunch of detail here. The chairman here wants to know what the bridges are, and where they are located. Then he can put a foot on one at a time as he progresses here.

Mr. ROYSTER. Right.

ESTIMATED COST OF PILOT PLANT FOR MANGASLAG PROCESS

Senator MALONE. I might ask you the other question because you are going to present that testimony, and I will presume you will be in the middle of it. Do you have any idea of what the annual cost would be for the first 2 or 3 years?

Mr. ROYSTER. You are speaking now of a pilot plant operation?

Senator MALONE. Going into it, yes.

Mr. ROYSTER. That would consist of two different parts, one would be the cost of putting the equipment together. You might call this the investment. Then you would have to operate the plant for a number of years after that.

Senator MALONE. I asked the question badly again. I know you are so familiar with it, and I have asked these questions a lot of times. Sometimes I do not get very good answers. If the chairman here is going to make a recommendation to the full committee for money to do this job, how much would you need in 1956, 1957, 1958, 1959, and 1960? That is the fifth year. If you do not know offhand, it does not matter.

Mr. ROYSTER. Would that be an appropriation coming in each year that had to go to the Treasury on the 30th of June of each year, or would it be a lump sum that could be spent as needed?

Senator MALONE. I do not know. We only have one way of appropriating money, I think. But there are a few people, and I think more in Congress all the time, becoming aware of these problems. I

do not think you are going to have much trouble. Do not worry about that. How much money?

Mr. ROYSTER. I would say it would not exceed $5 million total for the whole job, and probably it would be less than $4 million.

Senator MALONE. We put that many million out to foreign countries. I don't know why we are worrying about $5 million when it would make us independent of all entanglements for manganese.

That is all.

The CHAIRMAN. Thank you, sir. We appreciate your testimony here this afternoon. We will be glad to have any further information you may have.

Mr. ROYSTER. Thank you.

The CHAIRMAN. Mr. Clemmer will be the next witness. Before Mr. Clemmer starts, I will ask Senator Malone if he will take the Chair. I have another meeting to attend.

Senator MALONE (presiding). Mr. Clemmer, will you identify yourself for the record?

STATEMENT OF J. BRUCE CLEMMER, CHIEF, DIVISION OF MINERALS TECHNOLOGY, REGION III, BUREAU OF MINES, DEPARTMENT OF THE INTERIOR

Mr. CLEMMER. My name is J. Bruce Clemmer. I am chief of the Division of Minerals Technology for the Bureau of Mines, Region III, which embraces the States of North and South Dakota, Nebraska, Utah, Colorado, Wyoming, and Arizona.

Senator MALONE. Do you have a statement?

Mr. CLEMMER. No, Mr. Chairman; I do not have a prepared statement to present at this time.

Senator MALONE. You have heard the testimony, and you know what the committee is trying to do. Why do you not go ahead and give us the picture as you see it, and as you think it would be helpful to us.

REVIEW OF PRESENT STATUS OF STOCKPILING PROGRAM

Mr. CLEMMER. If it would interest this committee, I would like to review very briefly the present status of the stockpiling program of the General Services Administration, and give you some of my thoughts on what can and probably should be done with our present low grade stockpile of manganese ores. It may interest the committee also to review very briefly some of the research that we have done at our Salt Lake City, Boulder City, Nev., and Tucson, Ariz., experiment stations.

I was very happy this morning to hear the remarks of this committee on continuity of research. I have been in the Bureau of Mines service now for almost 27 years. When I entered Government service in 1929, the first job that I had with the Bureau was on the concentration of manganese ores, making flotation tests to see what we could do with upgrading our low grade manganese deposits. At that time, we had a cooperative agreement with one of the Cuyuna producers. I did work on the Cuyuna black ores. We built a small pilot plant which we operated at Crosby, Minn. It was a combination gravity concentrator and flotation plant. It was operated only about one season. Our processing costs were high, and other methods were coming

along at that time, so this pilot plant, which treated about 150 tons of low grade ore per day, was discontinued. At any rate, we made a start on the manganese program, but interest then waned and we lost our money. Consequently, we abandoned our program.

About 1939–40, when the Strategic Mineral Act became law, we again started a manganese research program. This was continued for 2 or 3 years. Heat was off on manganese again, and the programs were brought to a halt. That was the second time it was started and in neither instance was carried through to a successful conclusion.

In 1949–50, interest in manganese revived and the Bureau of Mines for the third time started a research program. Fortunately, the Congress was generous and appropriated funds for the construction of a large-scale pilot plant at Boulder City, Nev., primarily to demonstrate processes which had been previously developed in the laboratory, processes involving the physical upgrading of the Artillery Peak ores, and the chemical leaching of those ores. We have carried that program along for about 3 years, and we have obtained some rather remarkable technical results. These results, however, are not so favorable economically at the present price of manganese.

Senator MALONE. What are you referring to as the "present price" of manganese?

Mr. CLEMMER. Normally we speak now of a base price of manganese of $2.30 per long dry ton unit as set forth in the purchasing program of GSA.

Senator MALONE. Explain your dry ton unit, for the record.

Mr. CLEMMER. A long dry ton unit is 22.4 pounds of the chemical element manganese. It was mentioned this morning that we buy manganese ore in long dry tons. We quote steel in short tons.

Senator MALONE. But what is the difference in the dry ton? Describe the dry ton.

Mr. CLEMMER. The long dry ton constitutes 2,240 pounds of ore on a moisture-free basis. (Sample dried at 110° C.)

Senator MALONE. It is dry ore.

Mr. CLEMMER. Yes, sir.

Senator MALONE. None of it is ever entirely dry. What is the allowable moisture in a dry ton?

Mr. CLEMMER. Normally speaking, Mr. Chairman, the moisture content is determined by drying overnight at or about 110° C., and we consider it dry at that time. There may still be traces of moisture retained in the material, but it is a substantially dry product.

Senator MALONE. No running water in it, at any rate?

Mr. CLEMMER. No running water,

Senator MALONE. You may proceed.

Mr. CLEMMER. It has been my experience that we have started on at least three occasions I can recall and we have never gone through to a successful conclusion.

Senator MALONE. Do you have in mind what caused this change or what brought it about in each case, and then what changed it?

Mr. CLEMMER. I think at the time, primarily, manganese was high on the priority list, and everybody agreed we were not producing enough manganese for self-sufficiency in the United States, and, therefore, steps should be taken to improve our position.

Senator MALONE. You said in 1940 we had a splurge?

Mr. CLEMMER. It was the Strategic Minerals Act. I believe that was about 1940 or 1942.

Senator MALONE. Would that have been the Second World War that we were getting ready for, the reason that we appropriated a lot of money?

Mr. CLEMMER. Yes; that was the beginning of the Second World War.

Senator MALONE. Then you said 1950, did you?

Mr. CLEMMER. Around about 1949 or 1950.

Senator MALONE. That could have been this Korean war?

Mr. CLEMMER. The Korean situation undoubtedly emphasized the need for reinitiation of research.

Senator MALONE. What was the one before that?

Mr. CLEMMER. That was back in 1929, Senator. I do not recall what the background there was. I think it was primarily because this Cuyuna producer was interested in the possibility of separating and recovering the manganese from the Cuyuna black ores.

Senator MALONE. What do you call the black ores?

Mr. CLEMMER. Those are the black ores of Cuyuna that contain manganese as well as iron. Actually, on the Cuyuna Range they have three characteristic types of material, the so-called black ore——

Senator MALONE. A fairly dry high-grade iron, is it?

Mr. CLEMMER. Yes, it runs 30 or 35 iron, and around 6- to 8-percent manganese. They also have what they call the red ore, which may or may not be of almost identical grade, but it is less oxidized, we will say. They call it red. It is simply a color differentiation. The host rock is what they call carbonate slates. The brown and red ores are largely derived from oxidation of the parent iron ore, the carbonate slate.

Senator MALONE. In these spurts that we take, is it that Congress appropriates money for research during time of the war. But when the war is over we feel we are going to have perpetual peace, so we quit. Is that it?

Mr. CLEMMER. I believe that is about what has happened. But I believe the Congress of the United States has been extremely good to the Bureau of Mines. Unfortunately, the tendency is to do the research during emergency periods when it can be done less effectively.

Senator MALONE. Does it not take just about the length of the usual war to carry on these experiments?

Mr. CLEMMER. That is correct.

Senator MALONE. Then what good do they do?

Mr. CLEMMER. We have gone through three spasms of it.

Senator MALONE. You have never produced anything?

Mr. CLEMMER. I would not say we have not produced anything.

Senator MALONE. Well, you have produced something, but I mean we get no results that could not be secured if we would have one of these spasms in peacetime.

NEED FOR PEACETIME PROGRAM

Mr. CLEMMER. I think it would be much better planning to do the research and test work during periods of peace, to be prepared for an emergency, rather than to try to take on and absorb an overloaded condition.

Senator MALONE. If we had a going concern production in this country of three or four hundred thousand tons a year, or a half million tons a year, as was described here by the last witness, producing 61 percent out of the slag, or, we will say, 50 percent, and then out of the Cuyuna Range a substantial percent, would not the manganese emergencies slacken off?

Mr. CLEMMER. I believe it certainly would level out the peaks and valleys that we have gone through before. At least we would have the nucleus of a self-sustaining industry which we could rely upon in case of an emergency.

Senator MALONE. If you had the slag production and the cuyuna production as a going-concern production, would it not be comparatively simple during an emergency to speed it up?

Mr. CLEMMER. Yes; I would think that would be a logical assumption.

Senator MALONE. You would not have any research to do, but you would just put in more units?

Mr. CLEMMER. Research always will be continuing.

Senator MALONE. Of course. We know that. You are improving processes all the time.

Mr. CLEMMER. That is correct.

Senator MALONE. I am talking about the original research to start them with.

Mr. CLEMMER. This would be the research required to get a mill into production, so that we would be getting needed material from it. Further research on process developments is a continuing thing for years. What we are thinking about now is applied research, so that we can get an immediate return, at least within the foreseeable near future.

Senator MALONE. What you are trying to do now would be to dig up information needed to make a successful operation?

Mr. CLEMMER. That is correct.

Senator MALONE. Is it not the history of research that it takes considerable time, no matter what you are working on? We had a metal called aluminum, one called stainless steel, but did it not take years before they could work out the successful alloys in those metals?

Mr. CLEMMER. That is correct.

Senator MALONE. Then you had what you called the taconite ore up in Minnesota. We were subjected to scare headlines all the time that we were entirely out of iron ore. It took quite a while to work out a method of using the taconite ore, did it not?

Mr. CLEMMER. That is correct.

Senator MALONE. How long did it take?

Mr. CLEMMER. Some of the others here could probably give better statements on the work on taconite than I, but I would imagine that work on taconite had probably gone along for at least 20 years.

Senator MALONE. Is it not true of practically all metals and practically all ores, especially the lower grades, that it takes a considerable amount of time to work out a practicable method of using them?

Mr. CLEMMER. Yes, indeed. Research often does not pay dividends until after several very intensive years of hard effort in the laboratory. It takes time to work out processes. This morning we were speaking of, say, a 5-year research program. Even after the basic bench tests are completed, the next step, of course, is to carry through what we

call semipilot plant tests. Once those conditions of continuous testing are delineated, one can say, "Well, we can extrapolate these results immediately to a commercial plant."

However, it will take possibly 2 years for design and construction of the commercial plant. After that plant is in production, it will take nearly a year for the shakedown trial to work out the operating difficulties in a commercial unit, and it may well take longer than a year.

Senator MALONE. Is it not a fact that in practically every type of process and in every type of construction, the last mill you build will be the best, because you learn something all the time?

Mr. CLEMMER. That certainly is correct.

Senator MALONE. Most people get confused when they talk about manganese, or any metal, or even textiles or anything else. There is not any question but what there are places in the world that you can get practically any material you can name cheaper than you can get it here; is that not it?

Mr. CLEMMER. I would say so, especially on manganese.

PRICE FACTOR IN DEVELOPING DOMESTIC MANGANESE

Senator MALONE. If you can get your own plant with your own shifters and your own superintendents, and labor anywhere from 40 cents to $2.50, you can pretty well do it, can you not?

Mr. CLEMMER. Yes.

Senator MALONE. And you can beat your price?

Mr. CLEMMER. Yes, sir, primarily because of the difference of living standards and wage rates.

Senator MALONE. So when you are talking about a price in the United States, you are only talking about the difference in wages and the different in taxes and the difference in the cost of doing business here and in your chief competitive country. Would you not be entitled to have that difference in the price paid for the material?

Mr. CLEMMER. It seems to me, yes. That would be a solid economy.

TIME FACTOR IN DEVELOPING DOMESTIC MANGANESE

Senator MALONE. You heard the testimony this morning and that of the previous witness. If you were assured of continuity in the program, and you could pay your research people wages comparable to what they could get elsewhere, what do you think you could do in 4, 5, or 6 years in the manganese field?

Mr. CLEMMER. In the present state of our research I think if we were given another 5 years of a sustained program, with a reasonable appropriation, I believe we could perfect and develop our processes to the point where industry would be willing to undertake commercial production of manganese in the United States.

It may not be enough to supply our entire commitments, but at least it would be enough to help us out in case of an emergency. I am fully convinced that manganese technology has improved greatly in the last 5 years.

Senator MALONE. To clarify the record here, in terms of 46 percent grade manganese ore, how many tons are used? Is it around 2 million tons now?

Mr. CLEMMER. I believe it is around 1,600,000 or 2 million tons now that are required. Two million would probably be a better figure.

Senator MALONE. If the cost of production in this country, the difference in the wage-standard of living here, and, we will say, in India, where we are getting nearly a million tons a year, and the taxes and costs of doing business as between here and the Nation of India, were added to the price on some kind of a principle so that your investment was protected from this unfair competition, where do you think we might land in a going concern production in this country's industry?

Mr. CLEMMER. Probably the better sources of supply, other than steel plant waste slag, would be the Cuyuna Range in Minnesota, that being our largest reserve. Next would be the southwestern deposits in Arizona, the Artillery peak area, and the scattered deposits in New Mexico. We have scattered deposits also in Nevada with some in Colorado.

Senator MALONE. This 70-cent material shut Nevada down.

Mr. CLEMMER. Yes, 70 cents is too low.

Senator MALONE. How much of that 2 million tons of 46-percent ore do you think we could produce as a going concern?

Mr. CLEMMER. That is a very difficult question, Senator. Probably one of the quickest potential sources of added manganese in the United States, with higher price for an incentive, would be the Artillery Peak and its adjacent area in Arizona. I think if we considered that area we would probably decide upon a mill of about a thousand tons a day capacity.

Senator MALONE. The raw ore running what?

Mr. CLEMMER. Raw ore assaying perhaps 7- to 9-percent manganese.

Senator MALONE. What percentage of it would you say would be there?

Mr. CLEMMER. We have done a lot of research on the Artillery Peak ores. Actually, we feel that we can safely guarantee roughly 80 percent recovery of the manganese in a concentrate that can be sintered to standard specifications for high grade material.

I might mention, however, that most of the work was done on relatively high-grade Artillery Peak ore, if we call ten percent high grade.

Senator MALONE. If this thing were taken up seriously, do you think we could produce one-half of our annual consumption on a sustained basis, a going-concern production basis?

Mr. CLEMMER. I think one-half might possibly be a little high. Probably then to be conservative I would say perhaps we could produce 40 percent of our total domestic requirements.

Senator MALONE. That would be 700,000 or 800,000 tons?

Mr. CLEMMER. Yes.

Senator MALONE. I am talking now about a going-concern industry.

Mr. CLEMMER. I think it would have to be both on a guaranteed price and over a period of time.

Senator MALONE. How long?

Mr. CLEMMER. I would say at least 10 years, because industry is not going to build mills unless they can have at least a 10-year assured market for their materials. That much is necessary simply to amortize their investment.

Senator MALONE. If there was a principle laid down by Congress, and it were handled by the Tariff Commission, to have fair and reasonable competition, would that do the business?

NEW MAGANESE DEPOSITS

Mr. CLEMMER. I believe it would, if it were a flexible tariff. It might interest you, Mr. Chairman, on this low-grade domestic purchasing program the number of new mine deposits, that have been opened to adjacent or contiguous parts of the one area.

Senator MALONE. You are talking about Arizona?

Mr. CLEMMER. Arizona. Up to April 4, of this year we had received at Wenden a little more than 308,000 long tons of manganese ore. Those ores had come from 185 different mines. Unfortunately, the ore from 64 of those mines were what we call unamenable. We could not make specification grade concentrates from them, and consequently, we would not accept any further shipments from them.

Senator MALONE. What was the reason for that?

Mr. CLEMMER. There were a number of reasons. The present specifications call for a minimum of 15 percent manganese before it will be accepted at the depot. Furthermore, that ore must be amenable to concentration, to yield a concentrate assaying at least 40 percent manganese, with not more than 16 percent iron.

Senator MALONE. What would prevent that from being amenable to concentration to that analysis?

Mr. CLEMMER. Well, there are any number of reasons. Primarily, it is one of the interlocking of the manganese minerals. We have a lack of liberation, and, therefore, unless we have the individual minerals liberated, we cannot separate them.

Senator MALONE. What are the minerals?

Mr. CLEMMER. Almost every conceivable mineral. Most of our western ores, fortunately, are low in iron, but they do contain a great deal of silica, opal, quartz, clays, and various alterations of products. Some ores contain prohibitive quantities of other flotable materials, such as limestone and gypsum, each of which constitutes a separation problem.

Perhaps I ought to give the rest of these specifications for our concentrate. The concentrate must not contain more than 15 percent of combined silica plus alumina. In many instances that is the major stumbling block.

Senator MALONE. You cannot separate them?

Mr. CLEMMER. We cannot get them low enough to yield a product that will run less than 15 percent silica plus alumina. You have to get the sum of the two down to 15 and frequently that is almost an impossible task.

A few of the ores in the Southwest have also been rejected because of high copper content, but those are in the minority. It is primarily one of the silica and alumina rejection in order to make a 40 percent manganese concentrate meeting the other specifications or the percentages that I have mentioned.

Senator MALONE. Do you have any other information that you think would be helpful to the committee?

Mr. CLEMMER. I might mention also, since it might be of interest to the committee, the source of the ores that we have received at our

Deming, N. Mex., depot. Up to April 1, General Services Administration had purchased 134,000 long dry tons of ore, which came from 182 separate mines. The situation at Deming is a little more critical than at Wenden, so far as making specification grade concentrates. Some of the ores in that area appear particularly difficult to concentrate down to 15 percent of silica plus alumina. Of the 182 mines, 74 were shut off from shipments to the depot primarily because of our inability to concentrate the ores to the required analysis.

There are a lot of mines in Arizona, New Mexico, Nevada and Utah, which we didn't know existed before the low-grade purchasing program was initiated.

Senator MALONE. Is not the way you develop your new deposits, develop new reserves, to make it profitable to find them?

Mr. CLEMMER. That certainly is correct. If you give the proper incentive, industry will go out and do the job themselves.

Senator MALONE. How can you make it profitable to find them unless you had some kind of principle laid down, as I described a while ago, or a guaranteed unit price over 10 or 15 years as you described?

Mr. CLEMMER. I don't believe it can be done, unless you approached it from one or the other of those methods.

Senator MALONE. In recent years we have done neither, have we?

Mr. CLEMMER. Not to my knowledge.

Senator MALONE. In 22 years we had done neither.

Mr. CLEMMER. No.

Senator MALONE. Do you believe we have sufficient ores in the Nation?

Mr. CLEMMER. I think the low-grade purchasing program has brought to light a large number of deposits that we didn't know existed 5 years ago. Under a long-range purchasing program with an assured price, I am quite sure that other deposits will be opened up.

I might mention, however, the problem here at the depots. The ores are analyzed and tested by the Bureau as a service to General Services Administration. That work, however, is merely the preliminary laboratory work. Before we can convert those ores into usable form for industry, more work must be done. We should do more pilot-plant work to determine what our requirements for equipment are, what the flow sheet is going to be, what reagents will be required, and the recovery of what grade concentrates we can reasonably expect from an industrial going concern.

Senator MALONE. Do we have more manganese in sight now? Do we know of more manganese that can be used in an emergency than we had, say, 10 years ago? Do we know of more?

Mr. CLEMMER. Yes. I just quoted the figures. We have 84 deposits supplying ore to Wenden, and we have 76 that have been supplying ore to Deming which we have had to cut off for one reason or another. There are 140 deposits. If those mines contain a reasonable or large tonnage of manganese, we have a research problem on our hands, to determine what can be done to upgrade those ores which we have heretofore classified as unamenable.

Senator MALONE. What I am trying to get from you is what is your general experience and observation? Do we have less of these critical materials and minerals than we had 20 or 30 years ago, or do we have more?

Are the estimates of reserves greater now or less?

Mr. CLEMMER. I believe that actually the reserves are greater now than they were 10 years ago.

Senator MALONE. Or 20 years ago?

Mr. CLEMMER. Or 20 years ago. And I think they will actually increase under an assured purchasing program.

Senator MALONE. There is a general idea that has been sold to this country for many years, that we just have so much of each of these minerals and materials, and that every time we take a pound out we deplete it that much. Therefore, we should save our American reserves and import the necessary ores and critical materials.

Mr. CLEMMER. Well, of course, from the standpoint of industry, they will get their ores where it costs them the least money. But I think, by such a policy, we eventually sell ourselves down the river. We will not have a developed domestic industry of our own and, therefore, we will then be at the mercy of foreign nations. They may be friendly today and our enemy tomorrow, or vice versa.

Senator MALONE. I agree with your idea of industry or anybody else getting it where they can get it the cheapest, providing they stay with American producers, the American workingmen, and the investors up to the point where our wages and taxes and cost of doing business here and in the chief competitive country makes a difference. I think you could make that much more for the ore here on a principle, do you not, or do you?

Mr. CLEMMER. Yes, I believe you could. I believe, Senator, there has been too much of a defeatist attitude that has been accepted with regards to some of our strategic materials. It is true, we only have just so much developed, and, therefore, every pound we take out, as you say, leaves us one pound less in the kitty.

Senator MALONE. But if the record of all these metals, and I am sure you are correct, is that every year you discover more pounds than you take out, if the mining is profitable, then that changes the proportion, does it not?

Mr. CLEMMER. Yes, if it is profitable. Of course, looking ahead years and years, eventually, not in our lifetime, we will eventually run out of some of these materials.

Senator MALONE. Why do you say you are eventually going to run out? Of course, it does not make any difference how many million tons or trillion tons of manganese there are in the ground. Naturally, if you looked ahead a few thousand years you might say, "Well, we will use it up." But we are talking maybe about 50 years or a century, or the foreseeable future. You can very well run out of these materials by making it unprofitable to mine, can you not?

Mr. CLEMMER. Yes. Probably the industrial use pattern within the next century or two centuries will change, so that the things we use today will not be used in those times.

Senator MALONE. What is the difference between ore and country rock? Is not the definition that one is mined at a profit and the other is not mined at a profit?

Mr. CLEMMER. Yes.

Senator MALONE. Then if you can get the ore from India at 70 cents, you do not have any in this country at all, do you, unless there be a little in Montana as sort of a byproduct?

Mr. CLEMMER. I think with a 70-cent unit ore, probably the only production we would have might be from Anaconda.

Senator MALONE. And they might not even produce it there.

Mr. CLEMMER. I doubt seriously that they could maintain their operation at 70 cents. We don't have 70-cent manganese. If we have to get out and compete at 70-cent foreign ore, I don't think we have a ghost of a chance.

Senator MALONE. Then if we have to compete, if you must compete with the low cost labor throughout the world for manganese, tungsten, zinc, lead, or any of these materials, you just don't have much ore in this country, do you?

Mr. CLEMMER. No, sir.

Senator MALONE. That is defined as I defined it. It is ore that you mine at a profit, and if you cannot do that, it is country rock.

Mr. CLEMMER. That is right.

Senator MALONE. What is the subject we are trying to get at? Are we not trying to figure out at what price we can afford to pay to stay in business, and would not that be a reasonable assumption that if you paid the difference between the foreign price and the domestic price, the difference in the wage-standard of living and the cost of doing business here and in the competing country, would not that be a pretty good criterion?

Mr. CLEMMER. That would be a pretty good criterion, to take waste rock and make ore out of it.

Senator MALONE. I think you have made a good witness. If you have any material you would like to insert into the record, you may. Your testimony will be furnished you.

What we are looking for is information. If you will set your mind on it, round it out in any way you can to help.

Mr. CLEMMER. Thank you, Senator.

Senator MALONE. I have never seen this Congress turn anybody down on a program that they could see was headed someplace. I think you have the committee here that might recommend a program if they themselves can find out what they think it ought to be. The only place we can find out is from you folks.

Mr. CLEMMER. We will certainly be glad to help you in any way we can.

Senator MALONE. Thank you.

I think we will vary this order of witnesses, because the Bureau of Mines people are close.

We will next call Mr. Robert M. Lloyd of the United States Steel Corp.

STATEMENT OF R. M. LLOYD, VICE PRESIDENT IN CHARGE OF RAW MATERIALS, UNITED STATES STEEL CORP.

Senator MALONE. Will you identify yourself for the purpose of the record, and then you may proceed in your own way. You have heard some of the witnesses here and the questions, and you know what we are talking about and what the hearing is all about.

Go right ahead.

Mr. LLOYD. My name is Robert M. Lloyd. I am with the United States Steel Corp. For the purpose of conciseness, I have a written statement here.

I am very happy to have been able to accept your invitation to appear before you today and contribute in whatever way I am able to your investigation into the important questions concerning the stockpiling of manganese ore for defense purposes.

In order to introduce myself and at the same time to indicate the type of information which I am best qualified to supply you, I should like to take a moment to describe my position and the type of activity for which I am responsible.

I am a vice president of United States Steel Corp. and am in charge of raw materials. Acting in this capacity, it is my responsibility to assure my company of adequate supplies of basic raw materials required in its manufacture of iron and steel. In order to maintain the corporation's continued participation in a highly competitive market, it is necessary to obtain these materials as economically as possible under existing market conditions, and at the same time to assure that adequate supplies are available on an economic basis to supply the corporation's large and continuing needs in years to come.

TYPE OF MANGANESE ORE NEEDED BY STEEL INDUSTRY

I think I should begin my describing to you the type of manganese ore which the steel industry needs and indicating some of the problems which arise in connection with use of ores of lesser grades.

The most desirable blend of manganese ores for economical smelting to ferromanganese contains a manganese to iron ratio of approximately 8 to 1. Within the natural limits which apply, the higher the manganese content the more efficient the ore will be as long as this ratio is maintained. The silica and alumina contents of the ore blend should be as low as possible and should not exceed a combined total of 11 percent. On the average, such ore blend should not contain more than 0.12 percent phosphorus.

Other contaminators, such as zinc, tin, lead, and copper, even in small amounts, are deleterious, and the content of strong alkalis, such as sodium and potassium, should be very low.

For desirable physical characteristics the maximum size of lumps in manganese ore should not exceed approximately 5 inches and the content of very small particles, less than No. 20 mesh size, should be limited. In the case of dense, granular ores the fines content should be restricted to 7 percent through a No. 20 mesh screen, and the fines content of more porous ores should be limited to about 10 percent through a No. 14 mesh screen with not more than 5 percent smaller than No. 20 mesh.

DIFFICULTIES IN USING LOW-GRADE ORES

Ores with low manganese content can be used economically in mixtures with higher grade ores provided that: (1) The resulting average manganese content is reasonably high; (2) the resulting manganese to iron ratio is 7½ to 1 or higher; and (3) the slag-forming constituents are not excessive in the mixture.

However, as you will understand, only small quantities of lower grades can be used in mixtures since the material other than manganese will largely be either iron, which throws the manganese to

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iron ratio out of balance, or other materials, which increase the slag volume.

It is, of course, possible to use lower grade ores directly in ferromanganese production if neither time nor cost is any object. However, as the grade of ore decreases, the time and cost of producing a given number of units of ferromanganese increase out of all proportion and very soon materially affect the cost of steel-making. Furthermore, most ferromanganese is produced in the same type of blast furnace facilities as are used for the production of iron. Therefore, during periods of national emergency, when the country needs all the iron and steel which can be produced, although cost may not be a controlling factor, the additional time factor involved in producing ferromanganese from low-grade ores would make it necessary to divert blast furnace facilities from the production of iron.

CHANGES IN SOURCE OF MANGANESE SUPPLY SINCE 1948

In 1948 I testified with regard to manganese ore before the Subcommittee on Mines and Mining of the House Committee on Public Lands. Since then, the nature of the steel industry's requirements for this material has not changed, but other circumstances with respect thereto have changed radically. Prior to World War II, Russia was an important source of manganese ore. Although the steel industry in the United States got along without Russian manganese ore during World War II, depleted inventories of this material and increased steel production generated, during the postwar period, a large increase in demand for manganese ore. Russian manganese ore was available until 1950 and during 1948 about 30 percent of all manganese ore imported into the United States was of Russian origin. Around the end of 1949, apparently as a part of its cold-war strategy, Russia ceased shipments of manganese ore to the free world and a severe shortage of manganese ore developed in the United States.

As would be expected, this scarcity resulted in a large increase in prices. This price increase resulted, in turn, in the production for importation to the United States of large quantities of manganese ore which, at former prices, had represented marginal production and, hence, had not been mined. It also resulted in intensified exploration throughout the free world for new sources of high-grade manganese ore, which was successful in that industrially acceptable manganese ore is now being procured from many newly developed mines abroad.

To bring the picture up to date, the economic cycle has been largely completed. The huge new free-world sources and potential sources, the discovery and development of which were stimulated by shortages and high prices, have had, in turn, the effect of materially reducing the prices at which high-grade manganese ore is offered today in the free-world markets.

During the same period, after 1948, it is interesting to note the following:

First, in spite of the prevailing high prices for manganese ore from 1949 to 1951, there was no material increase in the amount of domestic manganese employed in this country. Anaconda Copper Mining Co. continued to be practically the sole producer of domestic manganese ore which offered ore to private industry at competitive prices.

Second, under the Defense Production Act of 1950, the United States Government purchased considerable quantities of domestic manganese ore. The prices established pursuant to this act were not even closely competitive with foreign ores.

Third, considerable research was undertaken by industrial concerns seeking economic methods of upgrading ore from available domestic sources. Similar research has also been conducted with aid of United States Government funds. These projects are continuing. Although my company is not faced with any urgent necessity for upgrading low-content manganese ores, it has, nevertheless, been active in research projects, seeking economically feasible methods for obtaining manganese in usable form from low-grade ores and from slag.

We are constantly seeking new sources which might be competitive with present sources. If an inexpensive method of upgrading domestic ores or of extracting manganese from slag is developed, the absence of long freight hauls could, of course, give these domestic sources an advantage. In such a highly competitive industry as the steel industry, we must always strive to develop technological processes which could reduce any of the elements of the cost of our products. To date, we have not developed a commercially feasible method of utilizing in our iron- and steelmaking operations the sources of low-grade domestic manganese ore available to us.

I believe industry and Government should continue efforts to discover methods of beneficiating domestic ores so that they will be economically useful. I believe also that Government should continue its program of developing new sources of foreign high-grade ores for stockpiling in this country. The question of whether continued subsidization of low-grade domestic manganese ores by means of Government purchases is in the public interest is a question more for the military than for industry.

The final resolution of this question requires, among other things, knowledge of the extent and nature of the present stockpile and a clear picture of how long a future conflict might be expected to continue.

I have indicated the limitations on the use of low-grade ore from the point of view of the steel industry, which, of course, have some bearing on this question.

PRICE OF LOW-GRADE ORES PROHIBITIVE FOR PRIVATE INDUSTRY

It is obvious that, unless economic methods of upgrading are developed, domestic ores cannot by any appropriate means be made competitive with other available ores. High grade foreign ores of a manganese content of 44 percent to 48 percent are now being offered in volume for delivery at North Atlantic ports at prices of 85 to 87 cents per gross ton-unit of manganese. Since such supplies are increasing, these prices may be expected to decrease.

It is my understanding that Government purchases of domestic manganese ore are authorized by regulations issued under the Defense Production Act of 1950 at increasing prices from 88 cents per unit for 15 percent ore to $2.30 per unit for 28 percent ore. Even if domestic ores were available in commercially usable grades, which they are not, clearly these price differentials would be prohibitive.

As a closing remark, I should like to say that it has been a pleasure to appear here before you today, and if there are any questions which any of you would care to ask, I will, of course, be happy to attempt to answer them.

Senator MALONE. You are associated with a very substantial company. Some of your phraseology needs a little interpretation for the committee. What are some of the costs in this matter of 11 percent turned into ferromanganese?

Mr. LLOYD. What I said, Senator Malone, was that it should be as low as possible and should not exceed 11 percent. The lower the slag forming constituents in an ore, the lower is the smelting cost. The amount of coke required is less, and instead of producing slag which is wasteful, you produce metal which is a usable product. The 11 percent is a measure that today represents as high as we would like to see the gangue content of our ores to produce ferromanganese economically.

Senator MALONE. You are talking about 11 percent ore in place?

Mr. LLOYD. No; I was talking of 11 percent silica and alumina content in the ores.

Senator MALONE. I understand now. If it contains more silica and alumina than 11 percent, then it is almost impossible to smelt it?

Mr. LLOYD. It is uneconomical to smelt it.

Senator MALONE. Regardless of how high these impurities are, or how low grade the manganese, if it is possible to make a ferro grade manganese at a cost that is comparable to the wage-living standards of this Nation and the wage-living standard of foreign sources, would you use domestic ores?

Mr. LLOYD. I am not sure I understood exactly your question. I think this, Senator; that the relative wage levels are not the full story.

Senator MALONE. With the effective wage standard of living here as compared to the effective wage standard of living abroad, and other costs of doing business here, do you think you should get the material abroad anyway if you can get it cheaper?

Mr. LLOYD. I think from the normal business standpoint, in order to be competitive we have to think of that.

Senator MALONE. Campetitive with whom?

Mr. LLOYD. With other producers in the United States and with other producers in the world.

Senator MALONE. You are referring to the fact that there is no cost of bringing anything into this country? You have your free-trade idea that there is no cost of importation, so you are competitive, then, with the nations of the world in your steel business, in your tool steel and all?

Mr. LLOYD. That is right, sir. That is our endeavor, to be there. I was going to try to say that in spite of our mechanization here, we have a great problem in dealing with low-grade ores because, as these gentlemen have said this morning, the type of ore we have in the United States, if we can beneficiate it to ore grade, is such that it takes the mining of 10 or 20 tons of material; it takes the treatment and grinding of that material; it takes the concentration of that material, and subsequently agglomeration of the material before it is ready for the smelting process. In the foreign countries, the deposits of manganese ore are such that essentially, again as has been said this morning, it is only necessary to dig them. With very slight

treatment they are ready for smelting purposes. We have a large difference in the problems.

Senator MALONE. Where are these deposits?

Mr. LLOYD. They are scattered throughout the world. There are known deposits in Latin America, in South America, in Africa, in India, in Russia, and, to minor extents, in Turkey and other countries.

Senator MALONE. Do you think there should be any account taken of the location as far as their availability in wartime?

Mr. LLOYD. Certainly, I do. As I say, I think this problem that we are talking about is one primarily of the security of these United States. And I think that if it is the judgment of Government that the United States needs the protection that is required by the development of domestic sources of manganese ore, then certainly in our Government's judgment it should proceed along that basis. The one matter that concerns me in that connection is that security is, in general, a matter of concern to all of the United States, and I think that whatever is done should consider that the load with respect to costs of that program should be borne by the United States as a whole.

Senator MALONE. I guess pretty nearly everybody uses some steel, don't they?

Mr. LLOYD. Yes. Some folks use more than others, but I think almost everyone uses some.

Senator MALONE. These people that use more than others use the material which they manufacture for public services of some kind for which they get paid, don't they?

Mr. LLOYD. In general, that is true.

Senator MALONE. If they did not get paid, they would not make much, would they?

Mr. LLOYD. If it did not pay, they would not make it—I don't think.

Senator MALONE. Office buildings, for example.

Mr. LLOYD. That is true. But there is the factor that, although steel has supplanted wood, there are in other instances cases where other materials are supplanting steel.

Senator MALONE. They are supplanting steel in concrete now?

Mr. LLOYD. Well, we have plastics. We have concrete, I guess, to some extent, too.

Senator MALONE. Are they making office buildings now out of plastics to any great extent?

Mr. LLOYD. No, but they are making many things out of plastics that formerly were made of steel.

Senator MALONE. Are those particular costs that might be added on account of the unit costs of manganese going to be the deciding factor in many of these operations?

Mr. LLOYD. It is hard to tell, sir. You cannot tell at any given time where you are competitive in an instance and where you become noncompetitive.

Senator MALONE. What is the difference? We have had testimony here this morning that there are about an average of 13 or 14 pounds of manganese that go into a ton of steel?

Mr. LLOYD. That would be the figure I would use.

Senator MALONE. That is this cleanser that we are talking about for the steel?

Mr. LLOYD. Cleanser and alloy as well; yes, sir.

Senator MALONE. In an average ton of steel, with a difference in the cost of a dollar a unit in the cost of manganese, what would that make in the average cost of steel?

Mr. LLOYD. Let me clarify this, if I may. The 13 to 14 pounds is per ton of ingot steel.

Senator MALONE. That is a ton of all steel, isn't it?

Mr. LLOYD. Yes, but in the ingot form. From the ingot, of course, are made various shapes and bars or whatever it might be.

Senator MALONE. Do you want to change your 13 or 14 pounds for all the steel turned out?

Mr. LLOYD. It is valid for ingot-tons of steel, but it is not valid for finished steel, and, as the number of tons of finished steel which is sold to consumers is considerably less than the number of ingot-tons produced, the cost to the consumer of the manganese used should be measured by the cost increment in a ton of finished steel rather than the cost increment in a ton of ingot steel. This cost increment, which the consumer must actually bear, is considerably higher than would be indicated by the increased cost of each ingot-ton.

Senator MALONE. I want you to clarify that for the record. How many tons of steel were turned out this year?

Mr. LLOYD. In 1954, to my recollection, it was in the neighborhood of 85,000,000 ingot-tons.

Senator MALONE. Eighty-five million ingot-tons. And 85 million by 13 pounds would be pretty close to the amount of manganese used, would it not?

Mr. LLOYD. That is correct.

Senator MALONE. Then any modifying statements you make to the contrary, that is about the amount of manganese you demanded?

Mr. LLOYD. That is right; yes.

Senator MALONE. And whatever that 13 pounds cost, it added that amount to the 85 million tons, each ton, on an average?

Mr. LLOYD. That is right, but it added more to the cost of each ton of steel produced in usable form.

COST DIFFERENTIAL IN USING DOMESTIC AND FOREIGN MANGANESE

Senator MALONE. All right. What I wanted to ask you was this: Suppose you are getting this manganese for $1 a unit—suppose you can get that from India or any place else across a major ocean—and you could get it for $2 a unit here, what would be the difference in the average price of that steel?

Mr. LLOYD. Well, let me say it this way: It is a little technical, I realize, but I would like to be exact.

Senator MALONE. I do not care how technical you are, just make it so the rest of us understand.

Mr. LLOYD. When you speak of manganese in ore, you are speaking of a product that is first smelted in an alloy and then introduced into the steelmaking process.

Senator MALONE. I am talking about the total cost of that whole process.

Mr. LLOYD. Well, the $1 per unit smelted into an alloy for the 13 pounds of metallic manganese that goes into a unit, will take, in essence, maybe 16 pounds of manganese in ore. So it would be, let us say, eight-tenths of a unit. So the difference in $1 a unit in the cost

of ore would represent, in essence, about 80 cents increase in the cost of manganese per ingot-ton of steel.

Senator MALONE. Just a minute. I am a little slow in arithmetic here. Will you explain that to me again? There are 22 pounds of manganese in a unit; isn't that right?

Mr. LLOYD. Twenty-two point four; yes, sir.

Senator MALONE. On the 13 pounds, then, you say it costs about 80 cents a ton?

Mr. LLOYD. That is what I am saying, Senator——

Senator MALONE. Let me finish. It is an additional 80 cents per ton?

Mr. LLOYD. A $1 increase in the price of a unit of manganese, based upon the figures we have been discussing, would result in about 80 cents increased cost in manganese per ingot-ton of steel.

Senator MALONE. You are going to get this testimony back and you can make any corrections you want to, and additions, to clarify it for the committee. We do have an economic structure in this country that they say is rather important in the national defense. You agree with that, do you not?

Mr. LLOYD. I do; yes, sir.

Senator MALONE. Your steel has some trouble, sometimes, if one of your chief customers has a little trouble, doesn't it?

Mr. LLOYD. We have complaints on quality, yes.

Senator MALONE. I mean, if one of your chief customers did not buy quite so much steel you would have more trouble than if they complained about quality, wouldn't you?

Mr. LLOYD. It is our job to sell steel; yes, sir.

Senator MALONE. I am not predicting you are going to have this, but stranger things have happened. So in keeping up this economic structure, this matter of manganese is just 1, perhaps, out of maybe 10,000 other units that are produced in the United States that you might be able to get cheaper someplace else. Do you think that ought to be carried right on through in all of the things that we can produce here? If we can buy them cheaper somewhere else, should we do that without any evener in price? Do you think that is a good idea?

Mr. LLOYD. Well, I could answer that in this manner, I believe: that we conceive our job is to give our customers steel at the best possible price that we can give it to them. As I said, particularly my job is to get raw material supplies as economically as we can.

Senator MALONE. Do you think it would be a good idea to import as many machine tools as we could without any evener on the price at all?

Mr. LLOYD. Well, I think, Senator, that comes down again to a matter of national security.

Senator MALONE. I am talking about the economic structure. I think it is the greatest thing in the world today, to preserve this economic structure. I am only 1 out of the 96 over here, but that happens to be my slant on it. If you can buy the things that you use or consume at the lowest price and sell your stuff at the highest price, that is wonderful. But let us say that everyone is going to have the same opportunity. Would you carry that right through to the final conclusion?

Mr. LLOYD. It is, of course, our job as citizens——

Senator MALONE. I know what your job is; to get as much for what you have to sell and buy the stuff as cheaply as possible. I asked you

a question, however. Do you think you ought to carry that right on through on all the products produced in the United States, get them anywhere in the world as cheap as you can get them, with no evener in price, no tariff or anything?

Mr. LLOYD. There are conditions that warrant one thing or another, perhaps.

Senator MALONE. What are they?

Mr. LLOYD. It is one thing as to whether or not the Government wants to direct that we should do things in a certain manner or not.

Senator MALONE. I do not want the Government to direct you to do anything, except where it might be something that you cannot do. Answer my question, if you will. Do you think you ought to carry that policy from manganese right on through to steel, all the products, electrical products and everything else, just wherever you can get them the cheapest to buy them, whether it be in India or anywhere else?

Mr. LLOYD. I would say that under normal business conditions we should live by the competitive basis that you are outlining. If, however, for security reasons the Government says that it should be done otherwise, then of course we would have to follow instructions.

Senator MALONE. I am leaving the security out of it. You look to me as though you have had some business experience. We all understand that if you can get an exception on what you yourself buy; and I am talking now about every businessman, he naturally is going to get it if the others get it. You have already said you want to get 70-cent manganese, high grade, from foreign countries. It is up to the Government to pay the bill if they want to produce some of it here for national defense. I only ask you the simple question. Do you think you ought to carry that right on through on every product on the books?

Mr. LLOYD. I thought I said that from my standpoint I believe in competitive industry.

Senator MALONE. Competitive with whom?

Mr. LLOYD. With everyone, wherever it might be.

Senator MALONE. All over the world?

Mr. LLOYD. Yes, sir.

Senator MALONE. I only want to know what you think for the record. I am not taking issue with what you think. In this country we have a fairly high standard of living. The wages run pretty high. There are some places where they just have not thought to pay any wages that amount to anything. Do you think we should follow the manganese principle that you have outlined right on through with all of the 5 or 10 thousand products that the American people use every day and compete evenly with all the world?

Mr. LLOYD. I think we have to, to have a competitive business world.

Senator MALONE. I think your testimony is very interesting. I appreciate your testimony. You are interested down in South America in various raw materials, aren't you?

Mr. LLOYD. Yes, sir; that is right.

Senator MALONE. In Venezuela you have iron deposits, do you not?

Mr. LLOYD. Yes.

Senator MALONE. What is the name of the mountain?

Mr. LLOYD. Cerro Bolivar.

Senator MALONE. I rode up on top of that, and it looked like an Ely copper pit converted.

Mr. LLOYD. I think that is a good description.

Senator MALONE. And it is about 60 percent grade?

Mr. LLOYD. That is right.

Senator MALONE. With very little impurities?

Mr. LLOYD. Very small amounts.

Senator MALONE. It looked like a wonderful operation. We went on down to the waterfront where you are shipping it, and we went out to the lake where the American oil industries have 3 or 4 companies there.

Mr. LLOYD. Yes, sir.

Senator MALONE. It is a very interesting operation. Do you have any manganese operations in South America?

Mr. LLOYD. Yes. We have been operating in Brazil for the past 33 years.

Senator MALONE. Where is that?

Mr. LLOYD. The operation we have at the present is in the State of Minas Gerais.

Senator MALONE. What is the name of it?

Mr. LLOYD. The name of our Brazilian subsidiary is Companhia Meridional de Mineracao.

Senator MALONE. Is this on the Paraguay River?

Mr. LLOYD. No, that is a new deposit in which we have an interest and which we are endeavoring to develop at this time. That is called Urucum. It is near Corumba.

Senator MALONE. There is another deposit down on the Amazon.

Mr. LLOYD. That is right.

Senator MALONE. I sent one of my engineers up there. I did not have time to get out. Has your company made any studies as to the availability of this material down there in time of war?

Mr. LLOYD. Yes. We have been guided largely by the advice of Government with respect to that.

Senator MALONE. What do they say?

Mr. LLOYD. They say that the Western Hemisphere sources are those that can be considered most safe.

Senator MALONE. Did they say anything stronger than that?

Mr. LLOYD. Well, I do not know that we asked them anything stronger than that. We did consult them as to what they believed about deposits in South America, and they said that they considered those more available than in other areas of the world.

Senator MALONE. Have you seen the report this committee turned out?

Mr. LLOYD. Yes, sir, I did. That is, your committee last year?

Senator MALONE. Yes.

Mr. LLOYD. I have seen it, yes.

Senator MALONE. Our best information, our conclusions from the best information we could get, was that these going concern operations down there could be kept available during wartime. Of course, there can be exceptions and accidents and a lot of other things, but the Western Hemisphere generally speaking, we concluded, was available. You certainly have a great operation down there. We did decide, however, that anything across a major ocean would not be available very long.

Mr. LLOYD. That is what I understood.

Senator MALONE. Mr. Lloyd, when we send you your testimony to be corrected, any details or any additions that you want to make will be received by the committee, because we feel, just speaking as one member, that you have a very efficient company and an efficient operation.

Mr. LLOYD. Thank you, sir.

Senator MALONE. Your testimony that you think of the world as a unit, with free competition, that we would last very long may not be the conclusion of some of us while others may believe that you are right about it.

M. LLOYD. I understand.

Senator MALONE. But the economic structure of this country is something that I would appreciate your giving some thought to. There has been a general feeling on the part of some of us that whenever the difference in cost of a domestic material or article and a foreign article did not exceed that difference in the wage standard of living, taxes, and the general cost of doing business here and in the chief competitive country on that product, that it might be a pretty good principle to establish to keep us in business.

Mr. LLOYD. I understand what you have said. As I have said. I think that you must be careful not to make such an approach discriminatory.

Senator MALONE. We thank you very kindly and appreciate your coming down.

Mr. LLOYD. Thank you, sir.

Senator MALONE. Mr. J. C. Douglas, will you identify yourself?

STATEMENT OF J. C. DOUGLAS, ELECTRO METALLURGICAL CO., NEW YORK, N. Y.

Mr. DOUGLAS. I am John C. Douglas, assistant works manager. Electro Metallurgical Co., a division of Union Carbide.

Senator, I do not have a prepared statement. I came down to answer your questions the best I could on the production and manufacture of ferro alloys and am best qualified to go into that field.

Senator MALONE. Could you make us a general statement along that line first? Would you like to?

Mr. DOUGLAS. Yes. Under the general subjects covered here today, it is the feeling of our company that we should pursue the use of low-grade manganese ores. I am referring particularly now to the ferro alloy industry and not the steel industry. Our company, over the last few years, some 10 or 15 years, has certainly done that with the ores available to it. We fully realize that our entire business right now is more or less dependent on foreign imports of raw materials.

Senator MALONE. You are talking now about manganese?

Mr. DOUGLAS. Yes. Also, during the past years, domestic ores coming to us and available on the market have been quite limited. We have used a number of these ores, some successfully and some unsuccessfully. It is our hope that your present program will continue to make available for the market ores produced in this country.

Senator MALONE. Let me ask you a question there. Much emphasis is put on the cost of these materials. Have you ever known a consumer in the United States to get the advantage of any decreased cost after

the foreign product has diminished the domestic production to any great extent, or at least to the point where it was no longer competitive?

Mr. DOUGLAS. Well, I will say this: That in the past 2 or 3 years there have been a number of reductions in the price of ferro alloys containing manganese, and the foreign market price of ore has varied over quite wide extremes during that time.

Senator MALONE. We are producing now a couple of hundred thousand tons of manganese because of a special piece of legislation. Do you have an idea that that price would remain around 70 cents or lower, providing we let this act expire and other production disappear in the United States?

Mr. DOUGLAS. Senator, I will have to qualify my answer to this extent: For the 200,000 tons that you have produced, I do not have any idea what the analyses might be. There are all types of manganese ore. As a producer of ferro alloys we have to discriminate between ores, so I am not in a position to give you an answer on that question.

Senator MALONE. I had more in mind what happens to imports when there is no longer domestic competition. We had an experience in several metals, and one particular metal, when during the war the price of mercury went up to around $300 a flask. It then went down to 70. Practically all of the domestic producers went out of business, and then it went up to about $250. The cost of foreign production did not go up, but the competition went out. What I am asking you is whether or not you would get the advantage of a low cost foreign material, in your opinion, if we in the United States were no longer competitive in that field or in any field.

Mr. DOUGLAS. I think that you would get some advantage, depending upon the amount of production of domestic ore. As that increases——

Senator MALONE. What do you think would happen here if we did not extend the act to buy manganese at $2.30 a unit, and we just threw it on its own, with our wage standard of living, taxes, and costs of doing business here compared to Africa, India, and other points? What do you think would happen to the price of manganese?

Mr. DOUGLAS. There might be some slight change in the price of foreign manganese ore, but by making the change upward, you in turn bring in what has been discussed earlier here—some of the so-called marginal producers in the foreign countries who have to get rid of their ore in order to get money. They, in turn, are willing to put it on the market at a price lower than the established price at the time of mining. So your price drops again.

Senator MALONE. Do you think that would obtain right on through 3, 4, or 5 years or more? I even go back to the price of rubber. Before we made any rubber it did not cost any more over the general price, but it cost us a dollar a pound.

Mr. DOUGLAS. I certainly concede the fact that the program of improving domestic manganese ores would tend to lower the price of foreign imports. My feeling in that, Senator, is this: that I am certainly not in favor of blocking all foreign imports of ore, nor am I in favor of lowering the bars to the extent of hurting the American economy. It seems to me that there is some medium ground which apparently we are treading on now in our present program of import-

ing ores, and also supplementing that program by upgrading domestic ores, domestic manganese ores.

Senator MALONE. Do you think it ought to be on some kind of a principle or a long-range guaranteed price?

Mr. DOUGLAS. Senator, I am for America and the people that live and work here. However, I realize that there still is a medium ground.

Senator MALONE. What do you mean by "a medium ground?" I have been looking for the answer to this talk about a medium ground.

Mr. DOUGLAS. I wish I could give you a definition, but here is my feeling in general of medium ground: that if you let down all tariffs on these ores, then I do not know, unless you completely subsidize domestic mining, that you would ever get any mined in this country.

Senator MALONE. Then what would you base your duty or tariff on? Isn't there a principle that might occur to you?

Mr. DOUGLAS. Yes, there is a principle that might occur to me.

Senator MALONE. What would that be?

Mr. DOUGLAS. It would be simply this—an evaluation of the manpower available and the living conditions in those States which contain manganese ore that could be upgraded, and the economy of the people.

Senator MALONE. Would it make any sense to you to say that if you fix the duty—the Constitution calls it a duty—on the basis of fair and reasonable competition, the difference in the wage-living standard here, and standard of living here, and the taxes that you pay, and the chief competitive country, on a principle of that kind? Would that make any sense to you?

Mr. DOUGLAS. Well, it seems to me that we have two entirely different things that we are discussing here. No. 1, the majority of the foreign ores—in fact, all the foreign ores with which I am familiar—are ores which require practically no processing for turning into metallic manganese; whereas, the domestic ores certainly require considerable amounts of processing.

Senator MALONE. Don't you have to have a policy or a principle or something, even in your own business?

Mr. DOUGLAS. I assume you do. I do not know that you could have a fixed policy, though. It seems to me that, as much as I dislike saying it, it would have to be something flexible.

Senator MALONE. That is what I mean, flexible. Do you know what the 1930 Tariff Act says? Do you ever read it?

Mr. DOUGLAS. No, sir.

Senator MALONE. I will tell you. I wish you would read it when you go home. It has never been used. It says that the Tariff Commission, which is well equipped to do the job, determines that difference in the reasonable cost of production here and the reasonable cost of production abroad, but they can even take the landed declared customs duty cost and the difference. On that judgment of reasonable costs, they recommend the amount of duty.

Mr. DOUGLAS. I will read that.

Senator MALONE. I think it will be very helpful to you because there have been some pretty good men that have thought about this thing for 150 years. You have done considerable research in this field. Could you describe the progress of it or any of the results?

LOW-GRADE ORES IN SILICOMANGANESE

Mr. DOUGLAS. Generally speaking, this of the low-grade ores that Mr. Lloyd referred to here a few minutes ago, although they cannot be used in the production of ferromanganese, they can be used in the production of silicomanganese, which is an alloy going into steel the same as the ferromanganese. We have been able to successfully use some of these so-called low grade ores, admittedly blended with the high grade ore, in the production of that alloy.

Our problem is identical to Mr. Lloyd's, and I suspect any metallurgical industry, in that we do not like to smelt gangue material, from which we can get nothing metallic in the furnace. But over the last 20 years, I think we have gone a long way in producing ferroalloys, and particularly silicomanganese. Silicomanganese can be substituted to a certain extent in the steel industry for ferromanganese.

Senator MALONE. What type of manganese?

Mr. DOUGLAS. Silico. In bulletin No. 3 of the Contributions to the Metallurgy of Steel as prepared by the American Iron and Steel Institute, and on page 38 thereof, this statement is made, and I quote:

> Production of silicomanganese in 1948 was approximately 60,000 tons. It is estimated that about 30,000 tons were used solely as a blocking agent and the balance as a ladle addition of silicon and manganese. In case of an emergency, the steel industry could substitute approximately 200,000 tons additional of silicomanganese for 175,000 tons of ferromanganese and 36,000 tons of silicon in silicon-ferro alloys.

So some low ores can be used in the production of silicomanganese, domestic ores, which in turn will help in the conservation of manganese.

Senator MALONE. Regardless of the grade of the manganese to start with, whether it be 5, 10, 15, or 20 percent, if a process were developed that met the required grade of ferromanganese, then as far as use in the steel industry it would be just as effective?

Mr. DOUGLAS. That is correct.

Senator MALONE. You heard the testimony here this morning that in the Cuyuna Range, and also from the slag from the steel mills, there is a possibility of producing quite a bit of manganese that could be used in that manner, did you not?

Mr. DOUGLAS. I heard that statement. Sixty-one percent I believe, was quoted.

Senator MALONE. On slag?

Mr. DOUGLAS. On slag, and 40 percent on ore.

Senator MALONE. That is a theoretical statement, I suppose, but it comes from men who have spent a considerable portion of their lives in doing research. Do you think it has any foundation?

Mr. DOUGLAS. Yes, I think it does have foundation. The Bureau of Mines has certainly done an excellent job preparing ways to use domestic manganese ore. I certainly am in favor of them continuing with their program that they have underway now, and also the one which you asked them to proceed with.

Senator MALONE. Do you think that we should give any break to domestic industry at all; or do you believe, as the last witness, that you should compete on an even basis with all areas of the world?

Mr. DOUGLAS. No, I do not believe that we should compete entirely with all areas of the world. I think, first of all, that we should look after our own industry and people.

Senator MALONE. Do you have any further statement?

Mr. DOUGLAS. No; I do not, Senator.

Senator MALONE. You will get your testimony back for correction. One thing this committee has never done is to catch anybody in offside answers, because we generally call only the witnesses whom we think really know their business. If there is any additional information which you wish to bring to the attention of the committee, I hope you will not hesitate to do so.

Mr. DOUGLAS. Thank you, Senator.

Senator MALONE. Thank you very much.

(The matter referred to is as follows:)

ELECTRO METALLURGICAL CO.,
DIVISION OF UNION CARBIDE CORP.,
New York 17, N. Y., April 29, 1955.

Mr. JEROME S. ADLERMAN,
Counsel, Minerals, Materials, and Fuels, Economic Subcommittee,
United States Senate, Washington, D. C.

DEAR MR. ADLERMAN: In addition to the testimony already given, I should like to bring to the attention of the committee some additional information which might be of some assistance in not only formulating their plans for the stockpiling of domestic manganese ore but would possibly be an additional incentive for development of domestic manganese ore.

On page 168, I quoted from bulletin No. 3 of the American Iron and Steel Institute entitled "Contributions to the Metallurgy of Steel" covering the problems involved in the conservation of manganese. This statement indicates that silicomanganese can be, at least partially, substituted for both standard ferromanganese and ferrosilicons, and was based on the production of 90 million tons of steel per year. Using this as a basis, it can readily be seen that much greater tonnage could be utilized at the present steel rate although the percentage would possibly be no higher. For the production of silicomanganese, ores do not have to be upgraded to the extent that is necessary for the production of standard ferromanganese. Such being the case, the cost of upgrading might be somewhat less than the prevailing cost at the present time. It is my impression that the present program of upgrading domestic manganese ore is almost entirely for the ultimate use in standard ferromanganese. It is quite true that, generally speaking, any ore meeting the requirements for the production of standard ferromanganese could be used in the production of silicomanganese; however, this upgrading is not necessary for all of the ore. This would mean that, in all probability, some of the requirements for producing ores which are not acceptable to the Government receiving stations for upgrading to standard ferromanganese could be used for upgrading and meeting requirements for the production of silicomanganese. This problem could, of course, best be handled by the Bureau of Mines who, I am sure, are entirely familiar with the requirements for the production of both alloys.

I might also add that, if these now unacceptable types of ore are considered for stockpiling, it would be a very wise move to convert them into their metallic elements and stockpiled in that form rather than as raw ore. There are several basic reasons for this recommendation. The electrical power required to produce an alloy could be considered as a stockpiled item and would be readily available at a time when most needed. During a period of emergency, electrical power has always been a scarce item; whereas if conversion was done under more normal conditions, electrical power would in all probability be available. In addition to this, the Government would be stockpiling manpower at a time when it was more readily available. These items alone seem to justify the conversion of at least some of our ores into metallic form as an alloy and I firmly believe would allow additional production of ores not now suitable for upgrading into the limitations of the present Government specifications.

If I can be of any further service to either you or the committee, I shall be most happy to do so.

Yours very truly,

J. C. DOUGLAS,
Assistant Works Manager.

Senator MALONE. Mr. H. E. West, president of Manganese, Inc.

STATEMENT OF H. S. WEST, PRESIDENT, MANGANESE, INC., HENDERSON, NEV.

Senator MALONE. How are you, Mr. West?

Mr. WEST. I am fine, Senator.

Senator MALONE. Mr. West, you have been laboring with this situation for quite awhile.

Mr. WEST. That is correct, sir.

Senator MALONE. If you would identify yourself for the record and give us the benefit of your experience—and I guess you are having some now about which you are not so happy—we would appreciate it.

Mr. WEST. I am H. S. West, president, Manganese, Inc., and also president of Haile Mines. We operate manganese properties in New Mexico and in Nevada.

Senator MALONE. That is, you did operate in Nevada?

Mr. WEST. No, Senator. The strike is over. It is all over. It is another one of the economic losses of industry.

Senator MALONE. Would you give us the history of that mining operation out there, with your contract, and some idea of the cost of the finished product? We would appreciate it.

HISTORY AND PROGRESS OF THREE KIDS MINE

Mr. WEST. We have a contract with General Services Administration covering approximately 35 million units to be produced from what is popularly known as the Three Kids Mine. We also have a contract to upgrade roughly 285,000 tons of ore which the Government now owns and which was acquired in 1941 and 1942, and which is in the stockpile on that mining property. We started to design and erect the plant in 1950. It was completed in 1952. Our first interruption was caused by the breaking of a rotary kiln, which was 160 feet long and 10 feet in diameter. It broke right in the middle and fell on the ground. That is the first such accident in the recorded history of kilns.

We repaired that in about 5 months, and operated for a period of approximately 8 weeks when the entire heart of the plant burned down for a paid loss by the insurance companies of about a million and a quarter dollars. We again went to work and rebuilt the plant, got it back in operation in about 6 months, and in January 1954 we started regular production and have continued since.

We are today producing approximately 9,000 tons of average 48 percent manganese nodules, meeting all metallurgical specifications. Ours is an individual contract at a considerably lower price than the $2.30 price of the national manganese programs. Costs are high. Our average wage costs for the operation are $2.40 per hour. Our average payment for the entire payroll was $425 per man for the year 1954. Those are the figures reported to the Internal Revenue Department.

Senator MALONE. Is that a guaranteed annual wage?

Mr. WEST. No, but they earned it just the same. I mean they were paid that. That ranges from a scale of roughly $4,100 for common labor to roughly $6,600 for skilled labor, such as electricians.

Senator MALONE. What would you class as common labor?
Mr. WEST. The strong man and the weak mind pickax man.
Senator MALONE. You start right at the bottom?
Mr. WEST. Right at the bottom.
Senator MALONE. And what is the skilled labor?

DIFFERENCE IN WAGES AND BENEFITS PAID BY FOREIGN PRODUCERS AND DOMESTIC PRODUCERS

Mr. WEST. Mechanics, electricians—that type. I am advised by various sources that the average wage for the important foreign manganese producing countries, such as India, South Africa, Mexico, and so forth, is considerably below $2.50 per day, the wage running from below $1 per day to a maximum of around $6 per day.

Senator MALONE. Do they have any benefits to the personnel, the working men, such as our country has gone in for to a considerable extent, such as industrial insurance, unemployment insurance, and social security?

Mr. WEST. No, nothing like social security. But in most foreign operations they do have good medical and hospital service. They have to give the service themselves, and they have a certain amount of amusement facilities and so forth.

Senator MALONE. Our industrial insurance goes beyond the hospital. Don't we have quite a considerable record of payment for certain injuries?

Mr. WEST. Yes. Our hospitalization program covers the entire family.

Senator MALONE. Not only that, but if you have a disability, a permanent disability, don't you get paid?

Mr. WEST. Yes.

Senator MALONE. Do they get that same thing in foreign nations?

Mr. WEST. Yes, to a certain extent. I am speaking mainly from my own experience in operating in Mexico.

Senator MALONE. These are American producers?

Mr. WEST. These are American producers.

Senator MALONE. What happens, say, in India, and countries with that wage-standard of living? Do they have the same kind of care and payments?

Mr. WEST. No, of course not. The benefits they get are very meager compared with our payments. You can take the whole thing all the way through, and the wage scale just about represents the benefits the worker gets. Our wage scale is from 7 to 9 times what the foreign wage scale is, and our benefits are relatively high.

Senator MALONE. In these foreign countries, where they produce a similar product, what is the efficiency of those workers? Is there any method of comparison that you have every worked out, such as the cost of the finished product?

Mr. WEST. No, I never have. Every country would be different.

Senator MALONE. Of course it would.

Mr. WEST. In Mexico, our experience down there was that you would employ roughly 2 for 1.

Senator MALONE. What was the daily pay?

Mr. WEST. Their daily pay was about, roughly, one-eighth. I still have an interest in a mining operation in Mexico, and the pay there is about one-ninth of what we pay in Nevada.

Senator MALONE. In other words, it takes about 2 of the average employees there to make 1 average American employee?

Mr. WEST. That is correct.

Senator MALONE. But you could employ 8 and come out even, is that right?

Mr. WEST. Yes, sir.

Senator MALONE. So you are a little ahead?

Mr. WEST. Considerably ahead.

Senator MALONE. How do you compete?

Mr. WEST. Well, in certain products, such as manganese, it is impossible to compete.

Senator MALONE. That is, unless you are guaranteed a unit price?

Mr. WEST. Unless you are guaranteed a unit price.

Senator MALONE. Of course, you would have some kind of a policy or principle adopted on a duty or tariff?

Mr. WEST. That is correct.

Senator MALONE. You have heard the conversation here, and I dislike to review too much of it, but Congress is reviewing the policy now. Are you familiar at all with the 1930 Tariff Act?

Mr. WEST. I would not say so.

Senator MALONE. I think it would be well for all business people to take a look at it. It provides for that differential in cost, effective labor, the taxes, and the cost of doing business here; a reasonable cost of production here as compared with the reasonable cost of production with the competitive nation. In fact, those are about the words.

Mr. WEST. Well, of course, your foreign price is not controlled entirely by the cost of production because there is so much monkeying around with the money. That is something that the governments control, and there is no bottom to a Chinese price. If somebody would just allow me to take a roll of paper and write anything I wanted on it and call it money, I could pay anything, and do most anything. But so could anybody else. That is about the way most of these countries run.

Senator MALONE. They do manipulate the price of their money in terms of the dollar trade advantage.

Mr. WEST. Yes.

Senator MALONE. You are familiar with that, actually?

Mr. WEST. I know all about it.

Senator MALONE. Well, would you be in favor of some system whereby an evener in the price of considering that differential in the effective standard of living, wages, taxes, and everything else could be taken into account?

STEPS NECESSARY TO AID DOMESTIC MANGANESE PROGRAM

Mr. WEST. Something along that line should be worked out. As far as the manganese situation is concerned, with which I am particularly familiar, I think that the present price of $2.30 is very close to the required price to put most of the mines in the United States into operation, provided that enough time is given them.

Senator MALONE. What would you say in point of time? You are talking about a guarantee?

Mr. WEST. I am talking now if they would continue these programs and eliminate the 10,000 tons a year, which is not enough to put in even an efficient operation. As soon as they put that limit on, then they automatically limit it to a small operation which must, of necessity, be an efficient operation. If that limit was taken off, and a period of not less than 12 and up to 15 years, if possible——

Senator MALONE. For the reason of amortization, and assurance of return on the money in the investment?

Mr. WEST. And even your personnel. If you take a 5-year program, you are not going to get any topflight personnel to come and go with any company, and know that it is going to be over in 5 years. He is looking for a long-time connection. The common trend in industry today is in retirement pay and all that sort of stuff, and they have to stay with one company to benefit from that. Those jobs are open to them. Certainly in the manganese business you need the best brains possible. It is a tremendous problem. It can be solved.

Senator MALONE. You do in any research problem.

Mr. WEST. In any research problem.

Senator MALONE. You heard the testimony today, the testimony of the Bureau of Mines on the Cayuna Range and the slag dumps. Do you think if Congress took cognizance of the factors that you and others have enumerated here today and provided for a relatively long-term research program, with some indication that there would be a principle laid down on price or a guaranteed price over a period, that these things could be done?

Mr. WEST. I firmly believe it.

Senator MALONE. Do you think they can be whipped?

Mr. WEST. I know they can be whipped. I know most of the individuals who testified this morning, and I have known them over a long period of years. I have done a great deal of work with them. I know what they can accomplish. I have confidence in their work and in their statements. I fully believe that the Mangaslag program can be carried out to a successful conclusion, where unquestionably you could produce manganese for under $3 per unit. If you take credit for the other benefits, it is probably going to be cut almost in half.

Senator MALONE. You heard the testimony this morning that there would be byproducts that would cut it just about in half?

Mr. WEST. Yes.

Senator MALONE. Of course, that would look entirely different. You hear a lot of talk on two points. First, that we have a very limited amount of critical materials, and we want to save our critical materials by importing goods from the foreign countries. Second, the consumer is entitled to the lowest price whenever he can get it, meaning, of course, lower wages—just like you were saying. My own observation has been that, whenever it is profitable, you find more than you mine. If you have the money for development.

Development does not always mean in the same mine you are working in. Most outfits like yours have prospects. They pick up and discard these by the dozen. Maybe 1 out of a 100 come up with a mine. But if you do not have a little velvet out there at the end of the rainbow some place, you cannot do that.

Mr. WEST. That is exactly correct.

Senator MALONE. Give us your experience in that regard first.

NEW ORE DEPOSITS DISCOVERED WHEN PRICE IS FAVORABLE

Mr. WEST. Well, I have operated in both the Wenden stockpile district or depot district, and the Deming district. We produce at this time a partially ungraded manganese ore, averaging around 25 percent, which has been upgraded from around 12 to 13 percent, and supply to the Deming depot roughly 2,500 to 3,000 tons a month. In that particular area where there was possibly not over 10 known manganese deposits which even had the faintest resemblance to having a chance of being turned into a mine, Mr. Clemmer has just testified that they received ore from 182 separate mines. From my knowledge, working around that territory for the last 15 years, that is an increase of at least 150 or 160 mines right there that produced something and shipped in.

Senator MALONE. When you have a profitable production—every once in a while you discover a real mine, do you not?

Mr. WEST. That is right. We do it all the while. We have field forces out, geologists and engineers, looking at mines constantly. A price and duration of that price will make mines. If they should go in, if the Government should go in, to a long-term arrangement at the price they are already quoting, in my stipulation you would multiply the known manganese resources of the country several fold.

Senator MALONE. Not only the production, but in sources of supply.

Mr. WEST. That is correct. You take Aroostook County, Maine. No one knows what the manganese resources are up there. There are estimates all the way from 200 million tons to a billion tons.

Senator MALONE. Where?

Mr. WEST. In Aroostook County, Maine. It is a complex ore, but there is no question in my mind that if sufficient time is given, at a price around the $2.30 range, that that problem will be solved and it will be one of the largest manganese reserves in the world.

Senator MALONE. That will be on your 12 to 15 years of guaranteed price?

Mr. WEST. Yes.

Senator MALONE. Or a principle set down by Congress of that differential in the cost being represented by a duty or a tariff?

Mr. WEST. Either way it is reached, it is perfectly workable.

Senator MALONE. Take this Maine deposit, the Cuyuna Range in Minnesota, and all of these hundreds of deposits that have apparently sprung up over night after our bill passed their guaranteeing price. What would you say if Congress furnished the money for the necessary research over a period of 4, 5, or 6 years and guaranteed that price on a reasonable term of years, as outlined by yourself, or laid down a principle as already outlined? What might we be doing in the matter of production of manganese here in 6 or 8 years? What do you think might be done in this country?

Mr. WEST. I think you would get on the basis of producing a minimum of 33.3 percent of the requirements, based on requirements of, we will say, 2,400,000 tons a year, which looks about like the answer if you are going to run full capacity.

Senator MALONE. And would you then, if you had that going concern production, be able to materially increase your production in case of war?

Mr. WEST. You should be able, as a minimum, to double the production of any of the operations that were then in being, within 1 year. First, you know exactly the pieces of equipment you need. Second, you have a trained force. Third, you have worked the bugs out and you can take one trained man and put an untrained man with him and get good results in operation. So it could be explosively enlarged, and at a minimum doubled.

Senator MALONE. Many people in Government when estimating the amount of reserves available in the United States, added the non-reserves and said, "Well, when we use that, we are completely through."

There is nothing any more nonsensical than to say to a company, "You have 4 years' reserves, so when that is used up you are through mining." When you come around 6 months from there, you still have 4 years' reserve. When you come around 10 years from there, all of the reserves might not be in the same place, but you will still have 4 years of reserves, if you are making money. Isn't that correct?

Mr. WEST. That is correct.

Senator MALONE. You could not have too many years of reserves.

Mr. WEST. You cannot afford to spend a dollar a ton on reserves—we will say the costs—or more depending on the mine, and keep reserves 10 years ahead because the interest loss on your money makes the ore too expensive.

Senator MALONE. The stockholders would not take it?

Mr. WEST. That is exactly it. The stockholders would not take it.

Senator MALONE. I wish when you get your testimony back that you try to make it clear to the casual reader as to just how a successful mining operation is conducted. You have conducted several.

Mr. WEST. I would be very glad to.

Senator MALONE. And maybe out of how many prospects you produce something, and out of how many producers you get a mine. I am talking now of over 15, 20, or 30 mines. You do not get many real mines. An engineer grows old in the service. If he is successful in finding one good mine, he is a successful mining engineer, is he not?

Mr. WEST. That is right. Mr. Clemmer brought up the Artillery Peak District, and that is the way it should be referred to. It has always been known as the Artillery Peak Mine. That is just one mine in there. I think the estimates are that it has around 10 million tons of 12 percent ore. Maybe it is 12 million tons of 10 percent ore. Surrounding that is a district covering 30 or 40 miles, where there is several times that much ore, and it is being proven everyday at the Wenden station.

Senator MALONE. Where the farmers and storekeepers prospect in the wintertime?

Mr. WEST. The Wenden station has proved that there are millions of tons of ore around that station. They go in, and though they will buy 15 percent ore, you cannot afford to ship them anything less than 17 to 18 percent ore and break even. Therefore, all the 13, 14, and 15 percent ore is left in the ground. That is all available for an upgrading plant. That district is ready right now.

Senator MALONE. No one in Washington understands the mining country where even the farmers and the ranchers talk about spending a month or so prospecting in the winter or when they get the crops in. But if there is some money to be made, they do just that, do they not, a lot of them?

Mr. WEST. Absolutely.

Senator MALONE. I wish you would go into that a little bit.

Mr. WEST. Well. I think it is going to be necessary for Congress to take the bull by the horns and outline a definite policy.

Senator MALONE. We have a hold of one horn this afternoon. We are going to get this estimate in. Maybe you can help the Bureau of Mines in this estimate.

Mr. WEST. The Bureaus do not seem to function the way the higher echelons talk. Mr. Flemming was very interesting to hear, but the reaction you get in ODM is that they are going to do nothing.

Senator MALONE. You see, Mr. West, the way people in Washington talk they think you wait until the morning they want the ore and then you take a couple of broncs and hook them to a buckboard and drive up on the side of the mountain and cut off what you want. They do not know of the many men who died broke, but they do hear about the one who made dollars. So mining is a gamble from start to finish, but it is in the blood.

Mr. WEST. It is in the blood, and you have to have brave money to go into mining today.

Senator MALONE. I have another committee meeting which I will attend tomorrow on H. R. 1, extending free trade. I believe as long as that act is extended you will never be safe in this country on production of critical materials unless Congress should guarantee a unit price. I do not know how they can do it for any such length of time as you suggest, because you cannot bind the subsequent Congresses.

Mr. WEST. How do they have these 5-year programs, then? That is beyond one Congress.

Senator MALONE. They can make a contract with one contractor.

Mr. WEST. Our contract at Three Kids was originally a 10-year contract.

Senator MALONE. But if you do not have your contract made at the expiration of the appropriation, and the next Congress does not appropriate it, you cannot make any new ones, can you?

Mr. WEST. No, I guess not.

Senator MALONE. That is right. I hope you will give this a little thought and go into this picture because those of us here feel so inadequate trying to explain it, even to their own committees.

PROCESS FOR UPGRADING MANGANESE AT THREE KIDS OPERATION

Senator MALONE. You have an upgrading operation down there producing nodules, and you use processes that at least were new to me when I first heard of your operation. Would you mind describing your operation there?

Mr. WEST. Not at all. We use the oil-emulsion process. That process, I believe I am right in stating, was originally started by the Bureau of Mines back in the 1930's. They did not have very good luck with it. As Mr. Clemmer recited, their appropriations were cut and right in the middle of the program they just dropped it. When we took on the Three Kids property, we arranged with the Southwestern Engineering Co. to have the services of Mr. Robert Lord, who is a very well-known and outstanding metallurgist. We started on the oil-emulsion process, which is actually nothing but a mixture of oil and soap and a wetting agent.

Carrying on from where the Bureau of Mines had left off, we were successful in developing that process. So that is what we use at the Three Kids operation now. We use soap, oil, a wetting agent, and a little So_2. We produce then a manganese concentrate running roughly from 39 to 41 percent. We then take that concentrate and first we put it through calciner kilns to burn off the large amount of reagents that we require, due entirely to the fact that the ore is a very porous ore. It is just like a sponge.

First we have to fill all the interior spaces before we can get any to stick on the outside and act as a flotation agent. From the sintering kilns, which are carried at roughly a thousand degrees, it is moved into a nodulizing kiln where we must remove roughly about 1½ percent lead.

We add coke—petroleum coke is what we happen to use—to the concentrate and hold it in the nodulizer for a certain period where the lead fume comes off. It is just about like that cigarette smoke. In fact, that cigarette smoke is much coarser. That cigarette smoke will run from roughly 1 micron to 2½ microns in it, where this will run much less. So it is much finer material.

After the lead is fumed off we step up the heat at the nose of the nodulizer to around 2,300 degrees and come out with nodules, roughly from 2 inches down to a half inch. Those nodules carry approximately 48 percent manganese, about three-tenths percent lead, about 14 percent silica alumina, and minor quantities of copper and zinc combined, equalling less than two-tenths, and they fully meet our specifications. In fact, our specifications call for 45 percent manganese and our average is well over 48 percent.

Senator MALONE. You are selling that for $2.30 a unit?

Mr. WEST. No, sir. Our contract is considerably less than that. I believe that the price we get is restricted information.

Senator MALONE. Considerably less, though?

Mr. WEST. It is considerably less than $2.30.

Senator MALONE. After all of this work that you have described?

Mr. West. That is right.

Senator MALONE. What is the grade of manganese you start with out of the ground?

Mr. WEST. Roughly, 20 percent. It is a large open-pit operation. We will go underground in about two years.

Senator MALONE. I saw it the last time I was out there.

Mr. WEST. Yes, I know you are familiar with the property.

Senator MALONE. What would be the increase in the cost on the same type of mining operation if you cut the grade in half, down to 7 or 8 percent instead of what it is, or 9?

Mr. WEST. That is handling more material, but that is not our large cost. Our largest individual cost out there is reagent. We use reagents in tremendous quantities, far beyond any other operation that I have ever heard of. And that increases the cost. We will take Artillery Peak ore. This is as I remember it, the results given to me by the Bureau of Mines after they ran a test of several thousand tons through their plant at Boulder City, which does 36 tons a day, a ton and a half an hour, and which is a complete metallurgical plant ready to treat any ore.

In their final results they recovered 85 percent-plus of the manganese content of the ore in the form of a 35 percent-plus manganese

concentrate, carrying roughly 18 to 20 percent silica plus alumina. They then took that concentrate, nodulized it or agglomerated it, rather, by sintering, put it through an electric furnace, and came out with standard grade ferro, meeting all specifications. I believe their recovery was someplace in the neighborhood of 82 to 84 percent. That ore that they ran deliberately blended from the Artillery Peak ores, which range from 4 percent grade to 18 percent grade, to a grade of roughly 9.5 percent.

Senator MALONE. Roughly half of your percent?

Mr. WEST. Roughly one-half of ours. But where in our ore we use roughly 50 pounds of soap, 120 pounds of oil, and 8 pounds of wetting agent per ton of ore, the Bureau of Mines in their Artillery Peak program used 6 pounds of soap, 12 pounds of oil, and something under 2 pounds of wetting agent. You can see it is the ore that makes the difference. Your average manganese ore at Three Kids deposit is the exception. It is a wad deposit, very spongy, porous ore. Practically all other ores are crystal ores. Therefore, the reagent stays on the surface and immediately is acted upon.

Senator MALONE. Take these ores in Maine. Do you know about those?

Mr. WEST. Both of those ores cannot be treated by hydrometallurgy. It must be a chemical process.

Senator MALONE. I see.

Mr. WEST. And the manganese is actually dissolved out of the ore and then reprecipitated.

Senator MALONE. Today many people believe that anything necessary for national defense must be kept in some kind of domestic production. There are some of us who believe that we have an economic structure in this country so that the 5 or 10 thousand products that we have—hardly any of us have an intimate knowledge as to the number, or as far as cost and process—and we believe there must be some kind of a principle to preserve our economic structure in this country in addition to taking a handful of materials that you can show a need for in national defense.

Some of us believe that if we are going to hold this living standard that we deliberately built up, or our economic structure will be mortally wounded before very long.

There are many people who believe just as you heard the gentleman of the United States Steel testify here a little while ago that wherever you can get anything cheaper, regardless of the wage-standard of living or anything else, that is the place to get it.

Mr. WEST. Of course that applies to his particular industry, and human nature is human nature. Everybody has a selfish interest, but if that program was ever carried through in the economy of the United States, we would be in the worst tailspin we ever heard of.

Senator MALONE. We are carrying it through at the moment. We have an organization, the General Agreement on Trade and Tariffs at Geneva, with 34 nations, and it is in their hands. They do the division, but it is clear beyond someone taking care of themselves. Of course I do not agree with him. There are many products in the steel business that cannot compete, and in my opinion they will find that out pretty soon. However, if any company is big enough to own some of these companies in the low-wage standard of living areas, then

they have 2 caps on and maybe that works pretty good as long as the customers here have the money to buy the product.

Something has to be done and it just happens that we are talking about a product today that obviously cannot compete with the world in production.

Mr. WEST. Impossible.

Senator MALONE. So you have to face it. If you want to produce it in this country, you either have to fix the price where there is a profit in enough of the operation to keep the industry rolling or you have to have a principle of protection.

Mr. WEST. If you developed a domestic manganese industry to the point where it cost a dollar and a half a unit more than imports and equalled 33⅓ percent of total requirements and forced steel users to use one-third of their manganese of that quality and grade, and it would all be ferro grade, it would cost the steel industry roughly 35 cents a ton. That is just a fraction, a very small fraction, of what they have been raising the price of their product every single year for the last several years. That is purely insurance to the United States in time of trouble.

Senator MALONE. Forgetting national defense for a moment, let us talk about wage standard of living, taxes, and cost of doing business in this country. We priced ourselves out of the world market. The only way to sell wheat costing us 50 or 60 cents a bushel is to pick up the check between what the fellow in Europe will pay for it and what we pay the producers. That is no complaint on my part; that is facing what we are doing.

Mr. WEST. If we stop farm supports today, the economy of the country would fall right into a cocked hat.

Senator MALONE. There has to be some answer found for it. You have to make up your mind whether you are for our present standard of living or whether you want to average it with the world.

Mr. WEST. We will eventually pull ourselves down to their level. We cannot raise them to our level.

Senator MALONE. Many people in Washington believe you are going to raise them up to your level.

The reason I am spending a little time on this is because I know you are right up against this out there and you know how you stay in business.

Mr. WEST. Sometimes I wonder how we do. We have $5½ million in that venture out there. It is all our money. There is not a cent of Government money in it, not a cent.

Senator MALONE. However, they have to pay you more than the world price for you to save the $5 million from extinction.

Mr. WEST. A year and a half or two years ago when the world price was up around a dollar and a quarter, they were not paying us so much extra.

Senator MALONE. It is down now.

Mr. WEST. It is down now.

Senator MALONE. You needed this long contract; otherwise you would not have stayed in business.

Mr. WEST. No, we would not. We never would have rebuilt the plant after we had the fire loss if we had not had the time to go under this contract.

Senator MALONE. Unless you have this guaranteed price over a period of years or a principle of protection, how can you get new money to enlarge your business or go into a business in a new place in this same type of production?

Mr. WEST. You cannot. There is no such money available.

Senator MALONE. Then isn't this principle we are following a good way to finally just stamp out the business of the country?

Mr. WEST. That is exactly what will happen. If the programs are not continued and not varied so that you can put in an economic-sized plant, there will just be no business. It will just absolutely all collapse.

Senator MALONE. Wool now is on a subsidy, you are on a subsidy, and the farmers are on a subsidy. If everybody is on subsidy and suddenly Congress came in and did not appropriate the money for it some year, that would be it, wouldn't it?

Mr. WEST. Everybody would close.

Senator MALONE. In one country the taxpayers went on strike and started to march on the capital, which amounted to about the same thing. They just quit paying taxes, and their taxes are not as high as ours. If that happens, we would be out of business, too, wouldn't we?

Mr. WEST. Absolutely. Of course, if they would include taxes as part of the return to the Government, that would be a great incentive. If they would eliminate taxes on these speculative mining ventures until such time as you had recovered your bait, it would be a tremendous incentive.

Senator MALONE. I do not know the answer, Mr. West. All I know is that we do not have it and we better be looking around for it.

Mr. WEST. There is no question about that. I agree with you 100 percent, Senator.

Senator MALONE. Do you have anything further that you think would be helpful to the committee?

Mr. WEST. I do not think so, other than what I would like to include in my statement which I will make additions to with your permission.

Senator MALONE. That is all, then.

The committee will stand in recess until 10 o'clock tomorrow morning.

(Whereupon, at 5:20 p. m., a recess was taken until 10 a. m., Wednesday, April 13, 1955.)

UTILIZATION OF MANGANESE DEPOSITS IN THE UNITED STATES

WEDNESDAY, APRIL 13, 1955

UNITED STATES SENATE,
MINERALS, MATERIALS, AND FUELS SUBCOMMITTEE OF THE
COMMITTEE ON INTERIOR AND INSULAR AFFAIRS,
Washington, D. C.

The subcommittee met, pursuant to recess, at 10 a. m., in room 224, Senate Office Building, Senator Frank A. Barrett presiding.

Present: Senator Frank A. Barrett, Wyoming.

Also present: Senator Frederick G. Payne, Maine.

Also present: Jerome S. Adlerman, chief counsel of the subcommittee; George B. Holderer, staff engineer; and Robert Redwine, staff member; W. C. Broadgate, metals and minerals consultant to the chairman.

Senator BARRETT. The committee will come to order, please. Is Mr. Sims here? I guess he is not here.

Mr. ADLERMAN. Dr. Schnee?

(No response.)

Senator BARRETT. Mr. Joel Morris.

Mr. MORRIS. Yes, sir.

Senator BARRETT. Will you give your name, address and position, Mr. Morris.

STATEMENT OF JOEL MORRIS, SOUTHWESTERN ENGINEERING CO., LOS ANGELES, CALIF.

Mr. MORRIS. My name is Joel Morris, Southwestern Engineering Co. of Los Angeles. I am concerned with research and development work with the company.

Senator BARRETT. You have done some research work for the Government, have you not, Mr. Morris?

Mr. MORRIS. Yes, we have. We were given a research and development contract by Defense Materials Procurement about 3 years ago. It was primarily concerned with physical means of beneficiating low-grade ores in the continental United States. Originally the concept of the contract was for so-called wad ores, but the scope was increased, and part of our contract was examining the known deposits, and examining these deposits and taking samples in the areas which contained known deposits of manganese in the United States. In other words, the major areas of the United States.

(Discussion off the record.)

Senator BARRETT. I would like to have you tell in your own words, everything that will be of value to the committee in this matter that they are investigating here at this time.

Mr. ADLERMAN. Mr. Morris, what are your qualifications?

Mr. MORRIS. I am a metallurgical engineer. I have a bachelor of science in metallurgical engineering, and a graduate degree, and I am a licensed professional engineer with 8 years' experience, spending about 4 or 5 years with and around manganese programs.

To give you a little history of this, Southwestern Engineering Co. are engineers and constructors. We also for 35 years have had a laboratory engaged in research and development on various processes for companies, utilizing basic raw materials. We have developed processes and completed research, not only for manganese, but other strategic materials. Naturally in the course of our work we were engaged some 5 years ago by Manganese, Inc., and in our laboratories we developed what is called the oil emulsion method of treating slimy ores, which now is in use at Manganese, Inc.'s plant at Three Kids, Nev.

We also in the course of our work built a pilot plant at Pittston, Pa., for Mangaslag. We have also for private individuals treated and developed flow sheets, tested the amenability of 60 or 70 samples from various mines both in the United States and other places in the world.

RESEARCH ON MANGANESE ORES

We have on our own conducted a research development program aside from the assignment we had from the Government. Our approach to this problem—I am speaking in respect to the contract we had with Defense Materials Procurement for the possible beneficiation of these low-grade ores—was this. It was almost a foregone conclusion that very few of these ores could be upgraded in a physical manner to make what is called metallurgical grade concentrate material. We did meet with varying success in increasing the manganese ratio as much as 2 to 1 on some of the larger low-grade deposits. These deposits are the deposits in Aroostook County, Maine, Mount Maple, Hovey Mountain, Dudley Farm, the Batesville, Ark., area, Artillery Peak, Ariz., area, Cuyana Range, which probably are the major deposits in the United States.

We were able, for example, in the Aroostook County area to make as high as a 20 percent manganese concentrate with over 80 percent recovery of the manganese values, which is significant, because of the high weight reduction, and production of a good grade of concentrate.

We were instructed by one of the governmental agencies to stay within known methods. I bring this up because I think it is quite a serious thing to restrain research to known methods, because there are not any known methods that you can use on manganese ores, because if there were, these low-grade deposits would have been worked out or utilized a long time ago. It takes special methods. It took special methods for the Three Kids deposit and it will take special methods for each and every one of our low-grade materials. It is definitely a profound research project in every instance. It is erroneous thinking and a poor philosophy to issue orders that research must be done with known techniques.

Our research work continued on until we ran out of time in our contract. After that time was over, we continued on our own and have continued to do so, expending a considerable amount of time

and money in an effort to correlate some of the work that was already done, and even going further into the problem. We have made economic studies and performed certain pilot plant and laboratory work which combines not only work that we have done, but some of the more prominent processes, that is, many of these processes seem technically feasible. The Dithionate process, Nossen process, Sylvester process, etc. We have made an endeavor to take the work we have done so far, combine various combinations of these processes to finally come up with a metallurgical grade product.

Some of these things are very promising from a standpoint of producing a product for a reasonable price. What I mean by reasonable price might be the $2.30 a unit term which has been bandied around. We do believe there are good possibilities in that price range.

We have made some interesting discoveries ourselves. Being associated with two large projects like Manganese, Inc., and Mangaslag, we probably have a fair insight on the tremendous technical problems which will confront any organization attempting to create a commercial plant on one of these ore bodies or byproduct materials. Mangaslag in our opinion is technically feasible. There may be some problems of recovery. A big problem will be the supply of metallurgical coke. There was in the last war, if I am not mistaken, a shortage of metallurgical coke, not only from the standpoint of production of it, but the existence of large deposits of coking coal. The mangaslag process would require large quantities of now unavailable coke.

Along the lines of the open-hearth slag, which is a potential source of metallurgical manganese, we think the Sylvester process in conjunction with other techniques that we have developed has an excellent chance of producing an economic product for less than $2 a unit. By taking the Sylvester concentrate and processing it by low temperature known pyrometallurgical means, we can make a metallic iron product of excellent quality and a manganese product which you can then convert to ferro manganese by normal blast or electric furnace methods.

I have just returned from Europe where I spent two months in consultation with some associates of ours on these and other problems of a similar nature, and we feel quite strongly both from our own laboratory investigations and from actual pilot-plant work which is being done, and has been accomplished, that certainly this is one method of attack for this most valuable raw material. This process combination provides the possibility of solving the open-hearth slag problem with known methods and eliminating a lot of possible technical bugs which you may have in a new process, by adapting these existing process steps to make a suitable feed material for ferro manganese production.

We also in our work have been able to remove iron from manganiferous iron ores. Some of these methods have patents pending on them. We are also able to remove silicate alone from certain manganese ores, which will have a profound effect in combination with other processes which are under discussion.

NEED FOR PILOT PLANTS

It is our opinion that the situation as far as research is concerned is serious from this standpoint. There is a lot of technology available. Practically everyone in this room has something to contribute. It is not something that has to start today, the basic work has been accomplished. A further program should utilize the valuable experience that the operators of some of these pioneer plants, like the Anaconda Copper Co., Manganese, Inc., and the other people who are doing pilot-plant work, now have. The chemistry is spelled out. The question is the creation of prototype pilot plants which can be directly translated into production units.

There is no point, from our experience, in playing around with toy plants, because the production problems and the translation of this data into plants are engineering problems and not chemical problems. We must produce a plant that will make the product. From that standpoint we feel that some attempt must be made to organize a committee of industry and Government who would be able to administer this continued research, which should be over a period of several years without interruption in order to build up the quality of organization that you need to accomplish such a job.

A good example is the great strides made for conquering polio because of continued research over a long period of time.

In our atomic energy program: When we had a particularly ticklish metallurgical problem, if I am not mistaken they tried 3 or 4 avenues at one time, and the one that looked most likely was adopted. I think it is the same method used in developing some of our aircraft and guided missiles. Three or four people take the problem and it is solved by all simultaneously and the best result is adopted.

NEED TO RELY ON DOMESTIC STOCKS IN WARTIME

The question of price comes up. We ourselves don't believe you can rely on South American ores or Indian ores. In the last war a good percentage of the ore-carrying ships were sunk, and if we were to get into such a situation, the first thing that would happen would be that we would have to employ several tons of airplanes for every ship, and some submarines for every ship, and the national resources would be weakened by trying to protect these ore-carrying vessels. The manganese then would not be costing 70 cents a unit, but would probably cost $70 or $700 a unit by the time you add up all these costs. I think it is fallacy to lean on potential reserves in South America or other countries.

We have been able in this country to beneficiate and make usable products out of low-grade deposits in practically every instance. The taconite program has been a continuing research program over a long period of time and it seems to be successful now. We ourselves developed a process for the production of refined sulfur from low-grade sulfur ores—another resource which had not been tapped.

Mr. ADLERMAN. Mr. Morris, you have had a contract with GSA for this research work?

Mr. MORRIS. That is right.

Mr. ADLERMAN. When was this contract entered into?

Mr. MORRIS. If I am not mistaken, I believe it was 1951.

Mr. ADLERMAN. How much money was allocated for this research work to you?

Mr. MORRIS. I think the sum was $250,000.

Mr. ADLERMAN. What was the general area of your research? What did GSA tell you to do? What was the area you were supposed to cover in this research program?

Mr. MORRIS. As I said, it started out to be a known physical means of beneficiating wad ores, such as those in Aroostook County, Maine.

Mr. ADLERMAN. You say you were limited to known means?

Mr. MORRIS. That is right. That was spelled out in a letter of transmittal from the GSA.

Mr. ADLERMAN. Under your contract you were not authorized to go into any research on an individual basis? In other words, you had to take those known means of beneficiating and try to develop those, is that right?

Mr. MORRIS. Yes, sir, which we did to this extent. We tried to use some unique techniques to achieve the purpose. Other work was done on our own and with our own finances and not with Government funds.

Mr. ADLERMAN. Would that limit research if you were confined to using only known means?

Mr. MORRIS. It certainly would. I think it is exactly against the principles and purposes of research to limit it so that the technician cannot use his ingenuity and imagination to develop processes or techniques which would solve the problem under question.

Mr. ADLERMAN. Was it the purpose of the GSA to have you evaluate these other known means of research, or was it a method of improving?

Mr. MORRIS. I don't think it was a question of improvement as most of these ore bodies under question had never been tested before or studied before in this same light. We were also instructed to make flow sheets and so forth, which we did, and some economic studies, which we have done.

Mr. ADLERMAN. What types of ores did you go into? As I understand it, you took the Aroostook ores, the Artillery Peak ores, the Batesville ores, the South Appalachian region ores, and the stockpile ores at Wenden and Butte. Are those the ores you worked on?

Mr. MORRIS. That is correct.

Mr. ADLERMAN. Did you work on any other ores besides that?

Mr. MORRIS. I would say, "No."

Mr. ADLERMAN. The research that you did was more the mechanical type of process?

Mr. MORRIS. I would say our research was limited by the instructions from DMPA to restrict itself to what we call gravity concentration flotation, and so forth. We started to do some further testing along the lines of hydrometallurgical testing of various ores and their concentrates.

Mr. ADLERMAN. You did that on your own?

Mr. MORRIS. That is right.

Mr. ADLERMAN. You rendered a report to the GSA last August, I think.

Mr. MORRIS. That is right.

Mr. ADLERMAN. I would like to submit that report for the record. We do not have to go into that in detail at this time, but that covers all the research you did under the Government contract.

Mr. MORRIS. Yes, sir.

(The report referred to follows:)

SOUTHWESTERN ENGINEERING COMPANY,
Los Angeles, California, August 9, 1954.

Mr. EDMUND F. MANSURE,
General Services Administration,
Washington 25, D. C.

GENTLEMEN: Pursuant to our contract with GSA, DMP–35, our job S–5630, we are forwarding under separate cover 15 copies of our final reports made under the instructions and terms of our contract. The reports cover the following areas:

1. Maine
2. Arkansas
3. Tennessee
4. Arizona
5. Virginia

The work performed and reported upon has been highly interesting, and we feel the results attained represent a contribution to the basic information on our national reserves of highly important manganese. Briefly, we list below some observations made by our staff, in addition to those of the formal reports.

MAINE

The character of the manganese minerals and their close association with iron and gangue as disclosed in published reports indicated only remote possibility of beneficiating Aroostook ores by physical processes to meet GSA specifications. Therefore, the objects of our investigations were to recover concentrates upgraded in manganese suitable for further treatment by the more costly pyrometallurgical or chemical processes and to produce a maximum weight of tailing product sufficiently low in manganese content to be discarded without additional treatment. Thus, the capital costs for a secondary treatment plant can be materially reduced.

Our investigations included heavy media separation on ore crushed to $-2\frac{1}{2}$ inches and table concentration of the fine fraction. The greater portion of our investigations, however, involved flotation. Investigations also included reducing roasting and magnetic separation of flotation concentrates, the results of which are discussed in the report.

Viewed from the standpoint of the above objectives, most of the Aroostook samples responded satisfactorily to flotation resulting in concentrates appreciably upgraded in manganese. From most samples, a large weight of tailing plus middling was produced sufficiently low in manganese content to be discarded without further treatment.

It seems especially interesting to note that flotation of several samples probably too low in manganese tenor for treatment by other processes produced concentrates equivalent in manganese content to the better grade of Aroostook ores. This indicates that extremely large tonnages of very low grade Aroostook ores can be beneficiated to produce suitable grade feed for other processes.

The report discusses possible processes for further treatment of flotation concentrates. Direct leaching of the raw concentrates would seem to be a highly desirable treatment. A single preliminary leaching test employing conventional SO_2 solution conducted on flotation concentrates from Maple Mountain-Hovey Mountain ores dissolved 50 percent of the manganese and little of the iron and phosphorus. It seems reasonable to anticipate that higher manganese extraction would result under more favorable conditions. (The manganese in the Dudley deposit is understood to respond more readily to leaching than that of the Maple Mountain-Hovey Mountain ores.)

Preliminary low temperature fusion experiments (2300–2400° F.) intended to indicate the possibility of removing iron from flotation concentrates, showed that as much as 80 percent of the iron was recoverable in the metallic state together with a portion of the phosphorus, leaving the manganese in the slag product.

In our opinion, a program of thorough investigation of the various hydrometallurgical and pyrometallurgical processes by which the flotation concentrates might be further treated is amply justified. In such a program priority probably should be given to leaching of the manganese from the raw concentrates.

We believe that the laboratory flotation tests obtained are sufficiently good to warrant confirmatory testing on a continuous pilot plant scale.

ARKANSAS

The primary object of investigations on the wad ore samples from the Arkansas area was to effect beneficiation of the manganese by physical processes.

Investigation by gravity concentration processes showed that a larger proportion of the manganese in these samples was contained in the coarser sizes than in the Virginia ores. However, 50–73 percent of the manganese was contained in the −35 mesh which made impossible high recovery by gravity concentration processes.

As with the Virginia wad samples flotation was indicated to be the physical process most likely to effect upgrading on the total ore. The iron content was identified by petrographic study to be present principally as goethite-lepidocrocite, the same minerals as contained in the Virginia ores. However, the physical association of these iron minerals with manganese appeared to be less intimate in several of the Arkansas samples than in the Virginia ores. Thus, appreciable upgrading of the manganese and selective separation from much of the iron was found to be possible with several samples. Leaching of flotation concentrates to lower the phosphorus content and reducing roast followed by magnetic separation to remove a portion of the iron were investigated.

Investigations included preliminary leaching tests utilizing SO_2, in some cases augmented by H_2SO_4. The results of these preliminary tests were not conclusive. However, taken with other leaching results as quoted in the report, the probable feasibility of such treatment is indicated.

Our investigations included development of procedures for desliming the crude ores and determined that considerable weight of argillaceous material could be eliminated from the Arkansas ores with relatively small loss of manganese. This desliming step would be highly important for practical application of a leaching process as the elimination of argillaceous slime would facilitate thickening and countercurrent washing operations.

In our opinion, thorough investigation of the Arkansas wad ores by leaching methods is indicated.

TENNESSEE

The samples of ore from the Tennessee area, 373–T and 374–T, were from the White Oak Mountain Mine and contained cobalt and nickel in addition to manganese.

The purpose of our investigations was to recover manganese, cobalt, and nickel by physical processes of beneficiation.

Investigations included heavy media separation and other gravity concentration processes, and flotation. Results of these investigations are discussed in the report.

None of the concentrates produced would meet GSA specifications in respect to manganese and silica plus alumina. However, upgrading of manganese, cobalt, and nickel was obtained.

Preliminary leaching tests were conducted on the crude ore samples employing conventional SO_2 solution, resulting in reasonably high extraction of the manganese. While extraction was not determined for cobalt and nickel, these elements appeared to be closely associated with the manganese and possibly were also dissolved.

A thorough investigation of the possibilities of leaching on both crude ores and flotation concentrates is warranted.

ARIZONA

The principal sample of manganese wad ore from the Arizona area was from the McGregor mine and our investigations were confined mainly to this ore.

The object of investigations was to upgrade manganese by physical processes of beneficiation to a product meeting GSA specifications.

First investigations were conducted by heavy media and heavy liquid separation, the results of which showed that some products could be obtained of a grade meeting GSA specifications in respect to manganese, iron, silica plus alumina, but with low recovery. Flotation was indicated to be the most feasible process for the physical beneficiation of this ore. Therefore, the greater portion of our investigations involved this process, the results of which were encouraging and are discussed in the report.

Flotation concentrates were below the minimum grade of 40 percent manganese required by GSA specifications and contained above the maximum allowable

lead content, but in other respects were satisfactory. After nodulizing, many of the flotation concentrates produced would meet GSA specifications.

In the treatment of McGregor ore, we believe that nodulizing should be considered as a necessary beneficiation step. In addition to accomplishing further upgrading of manganese, nodulizing is necessary to reduce the lead content.

Possibility of leaching the manganese from McGregor ore was not investigated.

In our opinion, the physical beneficiation of McGregor ore has been reasonably well investigated, and little, if any, further investigation is required.

VIRGINIA

The primary object of investigations on manganese wad ore samples from the Virginia area was to effect upgrading of the manganese content by physical processes of beneficiation.

Investigation of the wad ore samples, 350–V to 355–V, by gravity concentration processes showed that the manganese was contained largely in the fine sizes and was not amenable to beneficiation by such means. Flotation was indicated to be the physical process most likely to effect beneficiation of these ores. Upgrading of the manganese was effected by flotation on all samples. However, due to a large content of iron as goethite-lepidocrocite intimately associated with the manganese, only bulk concentrates were produced within the scope of our investigations. These concentrates were relatively low in manganese, high in iron and phosphorous, and would require further treatment by pyrometallurgical or hydrometallurgical processes as discussed in the report.

Our investigations included leaching tests utilizing conventional SO_2 solution. The manganese content of these wad ore samples was found to be readily solube in SO_2 solution, resulting in high manganese extraction.

In our opinion, thorough investigation by leaching to extract the manganese from these wad ores is clearly indicated. We recommend such a program of further investigation.

CONCLUSIONS

1. Nothing which we have developed has changed the original concept that the major manganese deposits in this country are Aroostook, Maine, Cayuna Range, Minn., the group of deposits in the desert range of California and Arizona, and to a lesser extent, the deposits in Virginia, Arkansas, and Tennessee.

2. The results of our work as reported herewith clearly indicates that none of these deposits with exception of Arizona, for one reason or another, are amenable to final upgrading by physical means alone.

3. Some benefits may be accrued by blending certain of the deposits, combining phosphorus free with high phosphorus ores, but the aggregate total resulting from this is of insufficient quantity to be of basic value, except as this may be added to the national available tonnage.

4. Because of the intimate chemical and physical association between manganese, phosphorous, and iron, particularly in the ores of Aroostook, and the larger deposits in Arizona, the disassociation of these by chemical means becomes apparent, and tests indicating the feasibility of this are shown in our report.

5. Several chemical processes and at least one pyrometallurgical process, all in laboratory or pilot plant stages, may have merit.

6. From our investigation, it would appear that the use of SO_2 leach under controlled temperature and pressure has the greatest possibility of success for the handling of large tonnage volumes, as laboratory examinations make this process feasible on all of the larger domestic deposits.

7. No equipment has yet been designed or put into commercial use which would prove its continued life, functioning under this process, so that research should be concentrated more to the end of proving full-scale mechanical equipment and its capacity for continued commercial life, rather than further laboratory or pilot endeavor.

8. We do not anticipate that any process involving the upgrading of large tonnages of low grade ore would be economically competitive, with manganese mined to grade with cheap labor and shipped to this country in bulk from foreign sources.

9. No commercial gain can therefore be anticipated from the development of any process or equipment in the production of manganese unless under government subsidy, and for national security the stockpiling of low-grade ores at high expense would be of limited benefit compared to a proven, but perhaps high-cost method, of producing extremely large quantities of high-grade manganese oxide when needed.

The preparation of the work has been under direct supervision of Mr. Robert Lord, chief metallurgist of our company, assisted by his technical staff and from time to time recognized consultants. We are honored to have prepared this work, and consider the contribution to our national welfare is apparent from the standpoint of alleviating the Nation's dependency on foreign sources of strategic raw materials, by showing the feasibility of upgrading the country's measure of manganese deposits through physical means as a step toward final refinement by pyrometallurgical or chemical means. The true benefit in this accrues from the tremendous savings in capital expenditure in the final process plants.

Sincerely,

H. V. HUGHES, *Manager, Industrial Division.*

Mr. MORRIS. We have also done considerable research since then which we would be pleased to submit for the record.

Mr. ADLERMAN. We would be very pleased to have a report on any other research you have done. If you could submit it now or any time in the very near future, so we could place it in the record, we would be glad to have it.

Mr. MORRIS. We will be pleased to do so.

(The information referred to follows:)

Since termination of its Government research contract (DMP–35), Southwestern Engineering Co., at its own expense, has continued laboratory research on the treatment of refractory domestic manganese ores. Among the phases involved in this program have been the following:

1. Development of the application of a pyrometallurgical beneficiation procedure (not conventional smelting) to remove iron from manganese-iron crude ores, leach tailings and concentrates. The products of this process are metallic iron low in manganese and in an upgraded manganese bearing slag. Much of the phosphorus content reports in the iron product.

2. Additional flotation research on Aroostook ores from the Dudley and Maple Mountain deposits with the object of obtaining maximum recovery of manganese and iron as a bulk concentrate for further treatment by pyrometallurgical and hydrometallurgical processes. In this procedure efforts are made to recover iron rather than to depress it into the flotation tailing.

3. Development of acid leaching procedures for recovering manganese from the upgraded manganese-bearing slag from iron removal. (Additional development work on these procedures is in progress.)

4. Development of manganese acid leaching procedures on the above mentioned Aroostook crude ores and bulk flotation concentrates.

5. An associated company has under development a beneficiation process which removes a high percentage of the silica content from manganese and manganese-iron crude ores and concentrates while leaving the other constituents in the beneficiated product.

An important phase of our continued laboratory research program is considered to be the application of the above-mentioned pyrometallurgical beneficiation process for removing a high percentage of the iron from bulk manganese-iron concentrates. The successful results of this procedure change the approach to preliminary beneficiation by flotation of such ores as Aroostook due to the iron content becoming a possible asset. Thus, it becomes no longer necessary to establish conditions for the depression of the iron and this reflects in higher flotation recovery of the manganese from the more difficult ores.

On the basis of this approach, a flotation test on a composite sample of Dudley deposit ores resulted in 88.66 percent recovery of the contained manganese and 65.92 percent of the iron in a bulk concentrate assaying 15.9 percent Mn and 21.12 percent Fe representing 63.67 percent by weight of the crude ore. Treatment of a similar flotation concentrate by the above-mentioned pyrometallurgical beneficiation process resulted in a metallic iron product assaying 93.72 percent Fe and 1.08 percent Mn representing 91.74 percent of the iron and 1.52 percent of the manganese contained in the flotation concentrate. The resulting slag product assayed 26.06 percent Mn and 2.64 percent Fe representing 55.92 percent by weight of the flotation concentrate or 33.13 percent of the crude ore. Leaching of the slag product resulted in a residue assaying 1.07 percent Mn and 1.98 percent Fe representing only 1.91 percent of the manganese and 1.21 percent of the iron contained in the crude ore.

Leaching of the slag resulting from pyrometallurgical treatment of Aroostook flotation concentrates for iron removal is considered advantageous because this product is upgraded in manganese and probably would represent only 33–40 percent of the crude ore weight.

While the foregoing examples are for Aroostook ore from the Dudley deposit, similar results were indicated for Maple Mountain ore. It is believed that similar results might be obtained on other manganese-iron ores. For example, a preliminary test on a sample of manganiferous-iron ore from Minnesota containing about 10.5 percent Mn and 37 percent Fe employing the above-mentioned pyrometallurgical procedure resulted in an iron product assaying 91.43 percent Fe and 3.80 percent Mn and a slag analyzing 41.08 percent Mn. Of particular importance is the application of these techniques to open-hearth slag. From the manganese-iron concentrate of the Sylvester process, one could make a high-grade metallic iron product and a high manganese slag suitable for conversion to ferromanganese.

Our associated company's silica removal process either alone or in combination with preliminary concentration and/or the above-mentioned pryometallurgical beneficiation procedure for removing iron should make possible the treatment of a number of refractory domestic manganese and manganese-iron ores. For example, a test by this silica removal process on a bulk manganese-iron flotation concentrate, which we produced from Dudley deposit Aroostook ore, assaying 16.3 percent Mn, 21.5 percent Fe and 18.4 percent SiO_2 resulted in a beneficiated product analyzing 20.0 percent Mn 26.5 percent Fe and 2 percent SiO_2. The other constituents present in the flotation concentrate were contained in the beneficiated product. After removing the iron from this product, the resulting slag might be suitable for smelting to ferromanganese.

Mr. ADLERMAN. Generally speaking, what are the principal types of beneficiation that can be used? There are the gravitation and flotation types. Then you have the chemical types. Are there variations in the chemical groups of research?

Mr. MORRIS. I would say this. Most of the so-called chemical types and hydrometallurgical techniques have been the leaching of manganese minerals or by various reagents, such as sulphuric acid, ammonia, caustic solutions, and then the precipitation of these salts, and then the subsequent calcining of these various salts to drive off either the ammonia or the SO_2, and then making a high manganese slag consisting mainly of manganese oxides. The Mangaslag process, and some of the other pyrometallurgical processes are chemical, too, only the reactions are in the furnace under different conditions.

Mr. ADLERMAN. The next big group would be pyrotechnical. That would be blast furnaces.

Mr. MORRIS. That is right; or some of the low-temperature techniques which we have developed such as the case of open hearth slags, where you can get a metallic iron byproduct as well as a high manganese slag.

Mr. ADLERMAN. Are there any other principal means of beneficiating outside of those you mentioned?

Mr. MORRIS. I don't think so. Between physical and chemical means, that pretty well covers it.

Mr. ADLERMAN. And pyrotechnical.

Mr. MORRIS. That is right.

Mr. REDWINE. I would like to ask one question.

In your opinion, talking about this limitation of the horizon in which you can do your research, the people who worked on polio, guided bombs, and missile programs, were they limited in their horizons?

Mr. MORRIS. I doubt it.

Mr. REDWINE. In your contract was there a definite objective that you were supposed to reach?

Mr. MORRIS. I do not think that anyone demands what I would call a definite result from research. We were attempting to make a metallurgical product from these low-grade ores as these means are far the simplest and cheapest process steps known.

Mr. REDWINE. But you had a definite fence about how far you could go in doing that?

Mr. MORRIS. Certainly.

Mr. REDWINE. That is all.

Mr. ADLERMAN. In your contract with the General Services Administration, how much supervision was there over your research program? Were any consultations had with the GSA experts?

Mr. MORRIS. We had limited visitations by their engineers in the course of the work, yes.

Mr. ADLERMAN. Did you have to make progress reports?

Mr. MORRIS. Yes; we made periodic progress reports. We were interrupted to this extent, that we were requested to do certain work which was given priority over other work for various reasons. We were interrupted during the course of our work to study the situation in Arkansas—the name escapes me at the moment—Westmoreland manganese project. We made a review of that project for the Government. That was under this contract. The contract was amended so we could make a review, which consumed some time, taking away from some of the research work. As I say, we ran out of time and not money.

Mr. ALDERMAN. The work that you did on the Westmoreland project, did that come out of the $250,000?

Mr. MORRIS. I believe so; yes.

Mr. ADLERMAN. In other words, that cut down your research funds even further?

Mr. MORRIS. That is right.

Mr. ADLERMAN. What proportion was it cut down by that?

Mr. MORRIS. I would not be able to tell you. I am sure that the figures are available. I would have to guess.

FUTURE BENEFITS OBTAINED FROM RESEARCH

Mr. ADLERMAN. Are you optimistic about the future beneficial results that could be obtained by research on these various ores?

Mr. MORRIS. I don't think there is any question that the problem can be solved. I do think that we should realize that there is not going to be any universal solution. Each ore body and each raw material will have to have its own solution. I think it has been the American method or the American technique to be able to solve such difficult problems. We have done it in other instances and manganese is no different; the only element is time.

Mr. ADLERMAN. In other words, the Aroostook ores differ from the ores in Tennessee and the ores in Cuyuna, and each will have to have a separate process?

Mr. MORRIS. Let us say perhaps 1 process could do more than 1 ore. Probably the most economic technique would be separate processes or combinations thereof.

Mr. REDWINE. I am wondering about this contract. Maybe you know and maybe you do not. Was the objective of your contract to reach only a certain point, and then for you to stop there, and some other contract with another research firm was to take over?

Mr. MORRIS. Our contract in its original scope was to try and beneficiate by physical means, so-called, these various ores.

Mr. ADLERMAN. I understood you to say before that you were able to beneficiate the Aroostook ores up to 20 percent.

Mr. MORRIS. That is right.

Mr. ADLERMAN. What were the ores that you started out with?

Mr. MORRIS. They ran from 7 to 9 percent. We took our own samples from cuts made by the Manganese Ore Co. in the last war, and cuts that were made by the United States Bureau of Mines. We opened up some of them ourselves under funds provided by the Government contract. Part of our contract was for field work.

Mr. REDWINE. This report you made to General Services Administration, did it cover the scope of only the work you did under that contract, or the work that you did on your own?

Mr. MORRIS. No, sir; only the work that was done under the contract. A lot of the work done on our own was done after the contract expired. We continued to work along the lines that were developed.

Mr. REDWINE. And substantial progress was made?

Mr. MORRIS. We believe so; yes.

Mr. ADLERMAN. And you have already said you will submit a report on that.

(The report follows:)

ENGINEERS PRELIMINARY ESTIMATE FOR MANGANESES RESEARCH FOR DEFENSE, INC., PREPARED BY SOUTHWESTERN ENGINEERING COMPANY INDUSTRIAL DIVISION, LOS ANGELES, CALIF., NOVEMBER 8, 1954

FOREWORD

This report is concerned with the engineering development and preliminary estimate of integrated facilities to be used for basic definition of methods, machinery, and equipment, which can be used for the concentration of manganese from major deposits in the United States and which, heretofore, have not been successful producers of this highly essential material.

In the development of the engineering, emphasis has been directed to the incorporation of various mechanical and chemical processes now known, assembled in such manner that great flexibility of operation is available, thus allowing the combinations of various preparatory methods to produce upgraded feed for final processing. Adequate space has been allocated for additions to the plant. Wherever possible, machinery and equipment has been placed out of doors, taking advantage of climatic conditions and reducing construction costs. The engineers' estimate has been prepared from quotations by equipment manufacturers. Labor and material costs were evaluated from the experience of Southwestern Engineering Co., as applied to a western site area. In the compilation, due consideration has been given the forecast of economic conditions, labor, and vendors' cooperation probable for the next 2 years.

SOUTHWESTERN ENGINEERING CO.

LOS ANGELES, CALIF., *November 8, 1954.*

Composite Cost Summary

1.0	Total site clearance	$5,798	
2.0	Total earthwork	39,935	
3.0	Total concrete	154,210	
4.0	Total steel construction	579,344	
6.0	Total other construction	7,059	
6.1	Roads and grading	33,878	
6.2	Railroad spur	45,595	
7.0	Total building	219,362	
7.92	Fencing	26,016	
8.0	Total, electrical	371,356	
9.0	Total piping	134,256	
11.0	Total process machinery and equipment	1,840,676	
12.0	Total instrumentation	56,928	
	Total		$3,514,413

Total includes $483,711 consisting of: Sales tax; payroll and labor area; small tools and consumable supplies; temporary facilities; equipment rental; and freight.

Total does not include the following:

Supervision	$92,324	
Purchasing and expediting	34,131	
Engineering	181,842	
Fee	98,497	
Total		406,794
Grand total		3,921,207

Estimated plant operating cost

1. Maintenance	$200,470
2. Operating supplies	1,014,657
3. Operating labor	541,370
4. Supervision	93,100
5. Power	165,564
6. Water	71,987
Total	2,087,139
Estimated total direct operating cost per year	2,087,139

PLANT NO. I

Ore is received by rail or truck, then conveyed to a two-stage crushing and sampling plant. Facilities are also provided to blend and bed the ore to provide uniform feed for further processing.

Plant No. I—Ore receiving and storage

1.0	Site clearance	$1,000
2.0	Earthwork	10,956
3.0	Concrete work	20,086
4.0	Steel construction	35,519
6.0	Other construction	3,652
6.1	Roads and grading	29,215
6.2	Railroad spur	39,319
7.0	Buildings	10,000
7.92	Fencing	22,435
8.0	Electrical	92,917
9.0	Pipe work	1,193
11.0	Machinery and Equipment	161,875
12.0	Instrumentation	5,006
	Total	433,173

PLANT NO. II

The concentrator includes a complete heavy media separation unit, grinding section, and flotation cells with all auxiliary equipment. The plant is so designed as to provide maximum flexibility to accommodate any flow-sheet changes.

This concentrator is designed to upgrade the raw ore to a minimum of 20 percent manganese as feed for plant No. III.

Plant No. II—Heavy media separation and flotation plant

1.0	Site clearance	$950
2.0	Earthwork	913
3.0	Concretework	18,260
4.0	Steel construction	34,352
7.0	Buildings	71,821
8.0	Electrical	93,891
9.0	Pipework	7,304
11.0	Machinery and equipment	355,233
12.0	Instrumentation	10,987
	Total	593,711

PLANT NO. III

This plant is a leach plant using the chemetals process. The feed to this plant is leached in an aqueous solution of sulfur dioxide, and further processed in high temperature autoclaves under oxidizing conditions. The autoclave discharge consists of a leached tail and a pregnant manganese sulfate liquor. Manganese sulfate is recovered from this liquor by subsequent processing, using evaporation, crystallization, and filtration.

A manganese dioxide sinter is then produced by sintering the manganese sulfate crystals; the volatilized sulfur dioxide gas is recycled to the leach circuit.

Plant No. III—Chemetals process

1.0	Site clearance	$1,200
2.0	Earthwork	6,087
3.0	Concretework	36,730
4.0	Steel construction	324,778
8.0	Electrical	67,074
9.0	Pipework	74,621
11.0	Machinery and equipment	644,358
12.0	Instrumentation	19,928
	Total	1,174,776

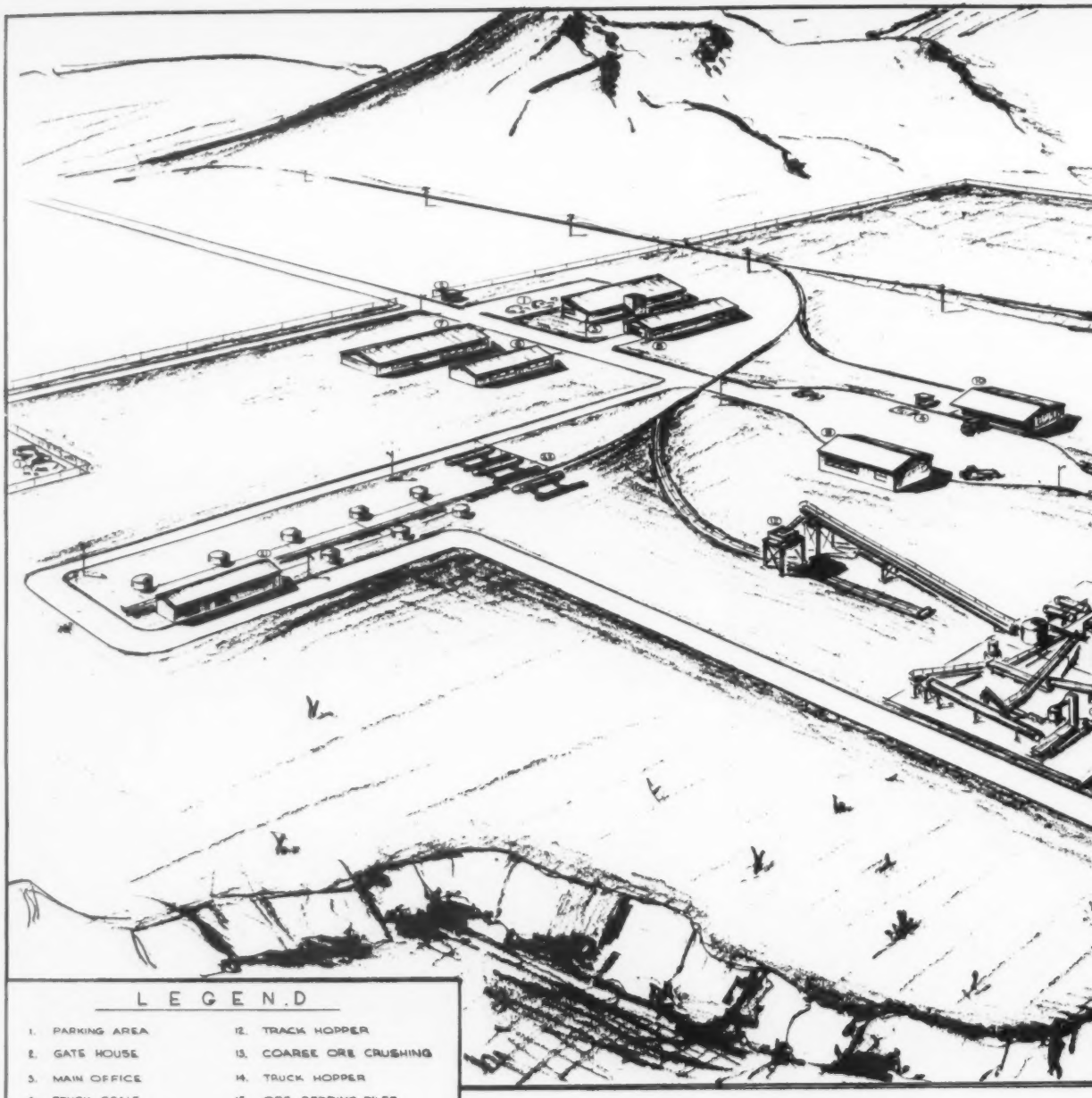
PLANT NO. IV

Plant No. IV is designed to take raw ore, or concentrates, and process them to produce high-grade feed for the leach plant (III).

As indicated in the flow sheet, facilities are provided for reagent additions, drying and calcining, high temperature reactions, cooling, grinding, and magnetic separation.

Plant No. IV—Kiln process

1.0	Site clearance	$500
2.0	Earthwork	779
3.0	Concrete work	33,525
4.0	Steel construction	39,336
7.0	Buildings	3,652
8.0	Electrical	20,573
9.0	Pipe work	6,878
11.0	Machinery and equipment	327,154
12.0	Instrumentation	10,117
	Total	442,514



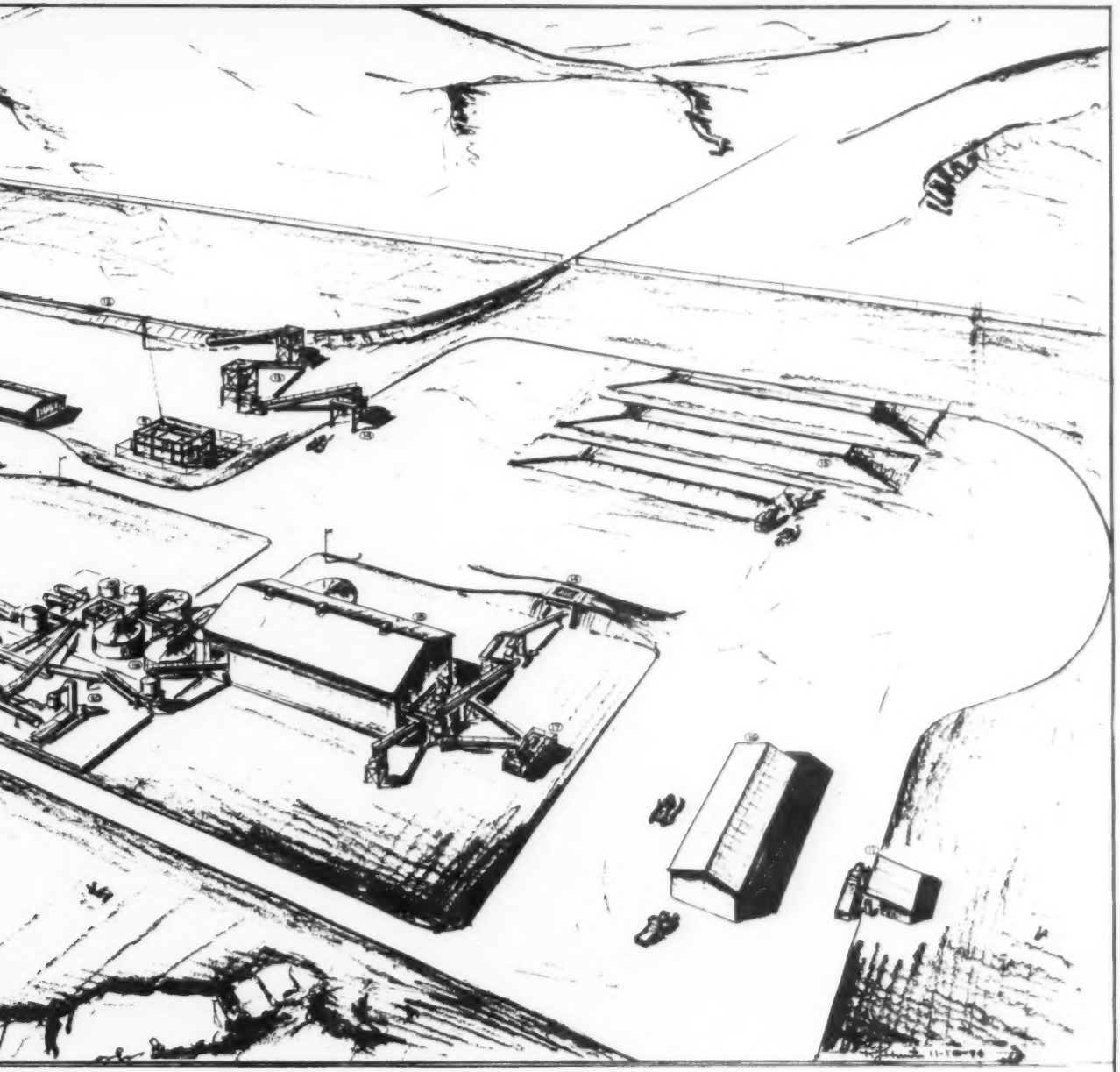
LEGEND

1. PARKING AREA
2. GATE HOUSE
3. MAIN OFFICE
4. TRUCK SCALE
5. MAIN SUBSTATION
6. CHANGE HOUSE
7. LABORATORY
8. FIRST AID & FIRE HOUSE
9. SHOP
10. WAREHOUSE
11. GAS STATION
12. TRACK HOPPER
13. COARSE ORE CRUSHING
14. TRUCK HOPPER
15. ORE BEDDING PILES
16. HEAVY MAINTENANCE
17. H.M.S. PLANT
18. FLOTATION BUILDING
19. CHEMMET PROCESS
20. KILN PROCESS
21. REAGENT STORAGE AREA
22. ACID STORAGE

MANGANESE

MANGAN

SOUTHWES

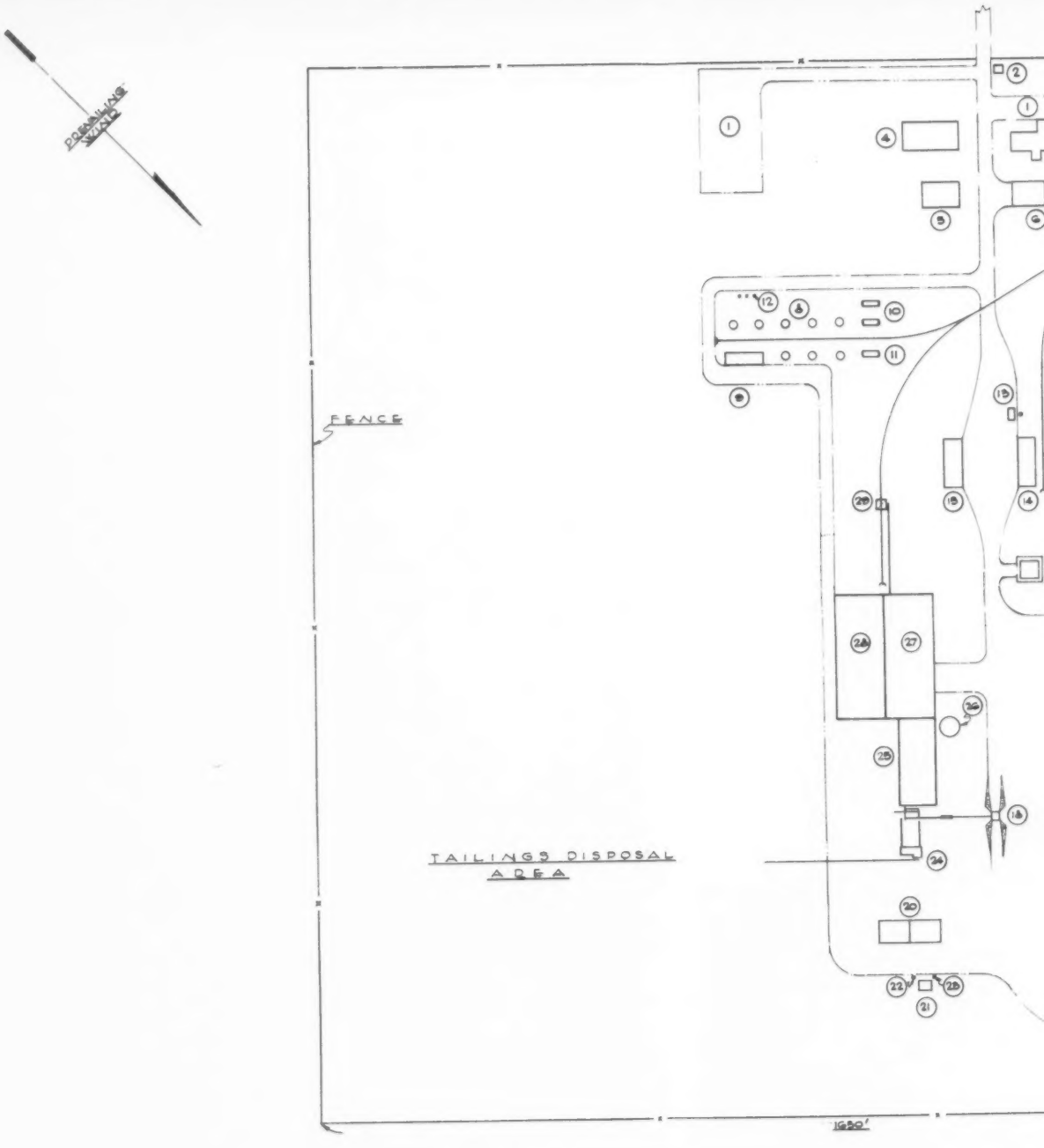


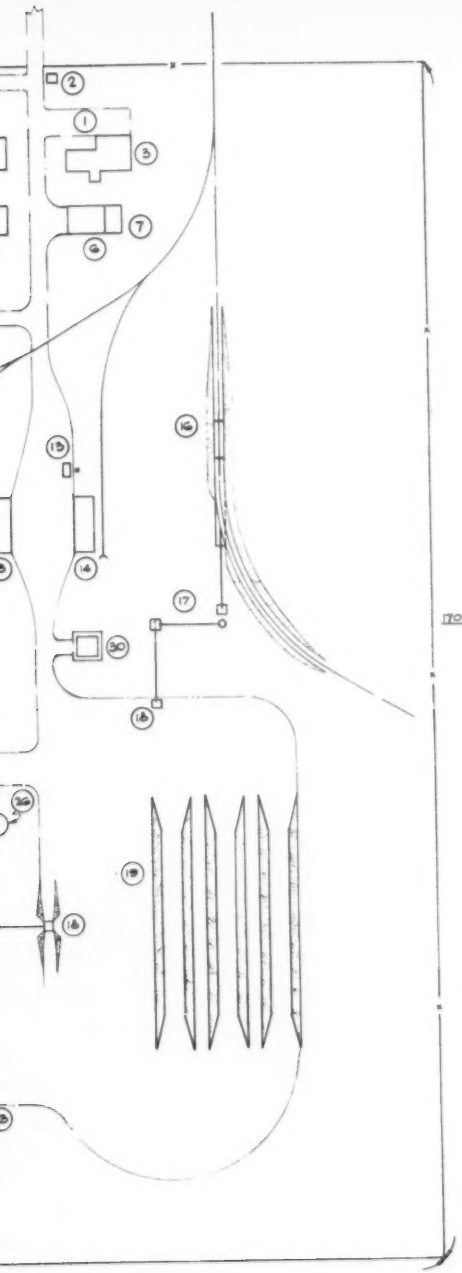
ESE RESEARCH FOR DEFENSE, INC.

GANESE RESEARCH PLANT

HWESTERN ENGINEERING COMPANY

DESIGNERS


DRAINAGE
WASH
FENCE
TAILINGS DISPOSAL
AREA
1320'



1	PARKING
2	PLANT SECURITY
3	MAIN OFFICE
4	LABORATORY
5	CHANGE HOUSE
6	FIRE STATION
7	FIRST AID
8	REAGENT STORAGE TANKS
9	DRY REAGENT STORAGE
10	ACID STORAGE
11	SO_2 STORAGE
12	TRANSFER PUMPS
13	TRUCK SCALE
14	WAREHOUSE
15	SHOP
16	TRACK HOPPER
17	COARSE CRUSHING
18	TRUCK HOPPER
19	ORE STORAGE
20	MAINTENANCE (HEAVY EQUIPMENT)
21	OIL & GREASE STORAGE
22	DIESEL PUMP
23	GASOLINE PUMP
24	H.M.S. PLANT
25	MILL BUILDING
26	THICKENER
27	CHEMMET PROCESS
28	KILN PROCESS
29	FINISHED PRODUCT STORAGE & SHIPPING
30	SUB STATION

SCALE

0' 50' 100' 200' 300'

X922

NO.	BY	DATE	REVISIONS

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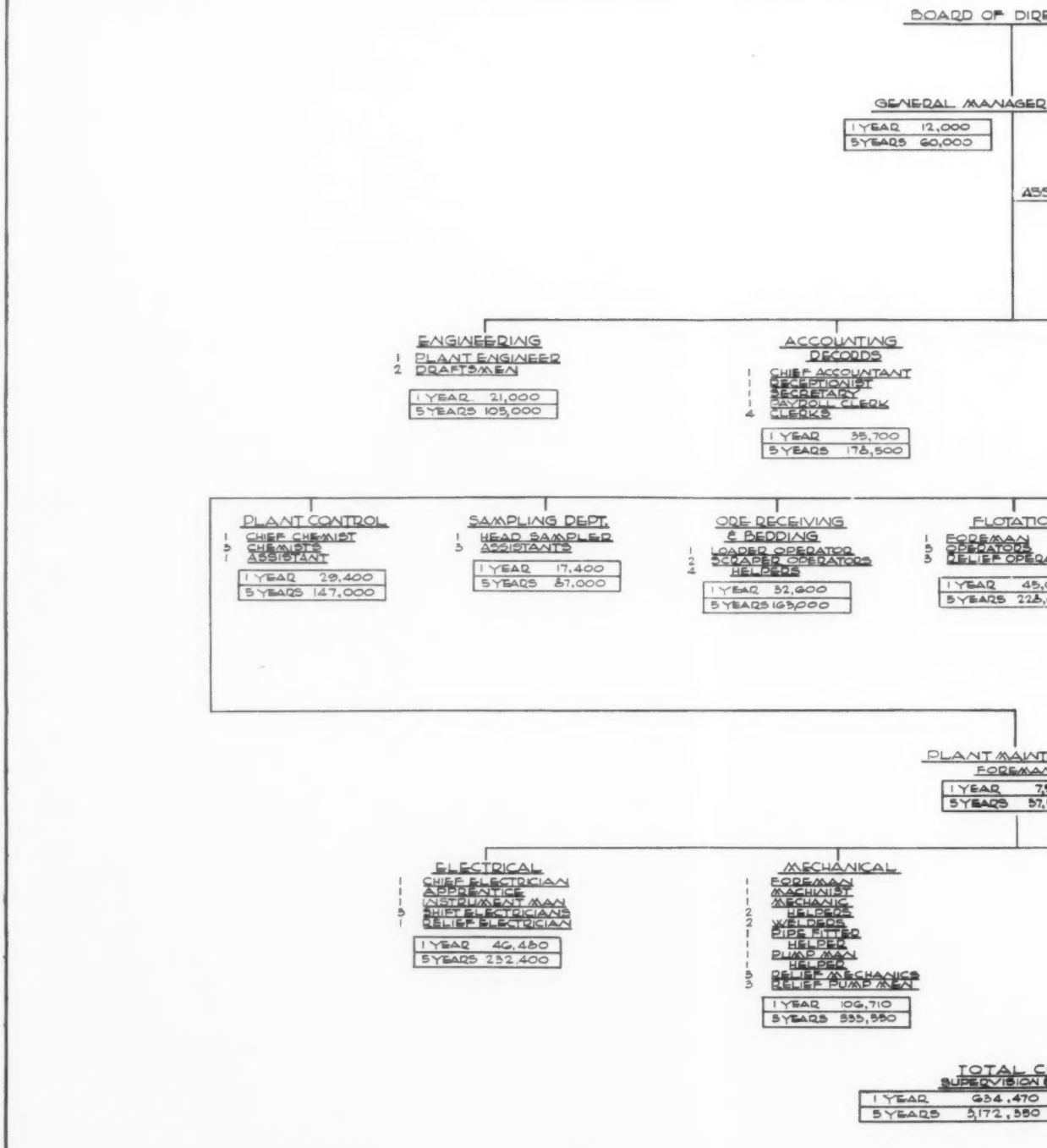
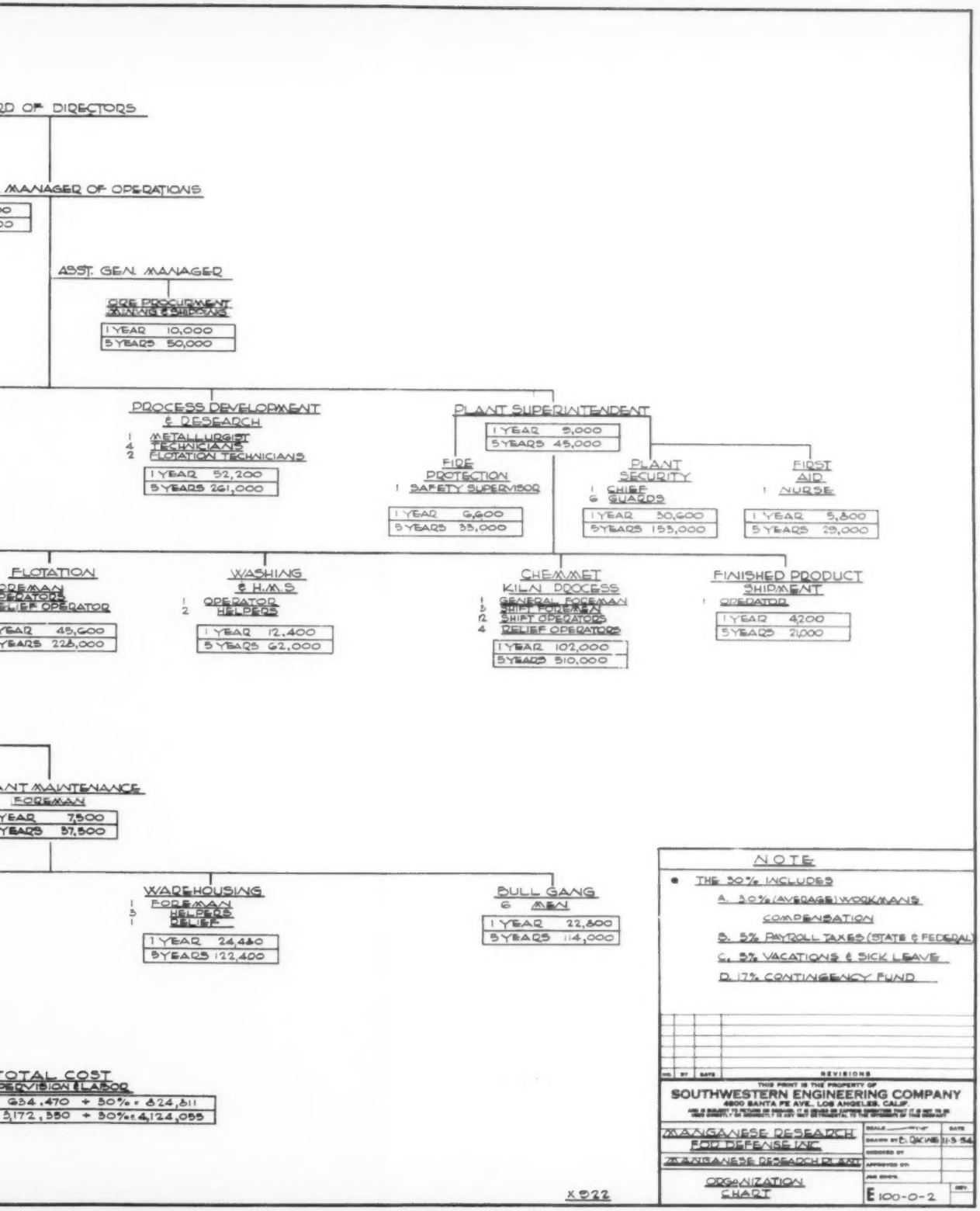
MANGANESE RESEARCH FOR DEFENSE INC.

MANGANESE RESEARCH PLANT

PILOT PLAN

SCALE 1"=100'	DATE
DRAWN BY D. DACUS	11-3-54
CHECKED BY	
APPROVED BY	
JOB ENG'R.	
E 100-0-1	REV. 0


BOARD OF DIRE
GENERAL MANAGER
1 YEAR 12,000
5 YEARS 60,000
ENGINEERING
1 PLANT ENGINEER
2 DRAFTSMEN
1 YEAR 21,000
5 YEARS 105,000
ACCOUNTING
RECORDS
1 CHIEF ACCOUNTANT
1 RECEPTIONIST
1 SECRETARY
1 PAYROLL CLERK
4 CLERKS
1 YEAR 35,700
5 YEARS 178,500
PLANT CONTROL
1 CHIEF CHEMIST
5 CHEMISTS
1 ASSISTANT
1 YEAR 29,400
5 YEARS 147,000
SAMPLING DEPT.
1 HEAD SAMPLER
3 ASSISTANTS
1 YEAR 17,400
5 YEARS 87,000
ORE RECEIVING
& BEDDING
1 LOADER OPERATOR
2 SCRAPER OPERATORS
4 HELPERS
1 YEAR 32,600
5 YEARS 163,000
FLOTATIO
1 FOREMAN
5 OPERATORS
3 RELIEF OPERA
1 YEAR 45,
5 YEARS 225,
PLANT MAINT
FOREMA
1 YEAR 7
5 YEARS 37,
ELECTRICAL
1 CHIEF ELECTRICIAN
1 APPRENTICE
1 INSTRUMENT MAN
5 SHIFT ELECTRICIANS
1 RELIEF ELECTRICIAN
1 YEAR 46,480
5 YEARS 232,400
MECHANICAL
1 FOREMAN
1 MACHINIST
1 MECHANIC
2 HELPERS
2 WELDERS
1 PIPE FITTER
1 HELPER
1 PUMP MAN
5 HELPERS
5 RELIEF MECHANICS
5 RELIEF PUMP MEN
1 YEAR 106,710
5 YEARS 533,550
TOTAL C
SUPERVISION
1 YEAR 634,470
5 YEARS 3,172,350


RD OF DIRECTORS
MANAGER OF OPERATIONS
ASST. GEN. MANAGER
ORE PROCURMENT
1 YEAR 10,000
5 YEARS 50,000
PROCESS DEVELOPMENT & RESEARCH
1 METALLURGIST
4 TECHNICIANS
2 FLOTATION TECHNICIANS
1 YEAR 52,200
5 YEARS 261,000
PLANT SUPERINTENDENT
1 YEAR 9,000
5 YEARS 45,000
FIRE PROTECTION
1 SAFETY SUPERVISOR
1 YEAR 6,600
5 YEARS 33,000
PLANT SECURITY
1 CHIEF
6 GUARDS
1 YEAR 30,600
5 YEARS 153,000
FIRST AID
1 NURSE
1 YEAR 5,800
5 YEARS 29,000
FLOTATION
OREMAN
OPERATOR
ELIEF OPERATOR
YEAR 45,600
YEARS 228,000
WASHING & H.M.S.
1 OPERATOR
2 HELPERS
1 YEAR 12,400
5 YEARS 62,000
CHEMMET
KILN PROCESS
1 GENERAL FOREMAN
5 SHIFT FOREMEN
12 SHIFT OPERATORS
4 RELIEF OPERATORS
1 YEAR 102,000
5 YEARS 510,000
FINISHED PRODUCT SHIPMENT
1 OPERATOR
1 YEAR 4,200
5 YEARS 21,000
ANT MAINTENANCE
FOREMAN
YEAR 7,500
YEARS 37,500
WAREHOUSING
1 FOREMAN
3 HELPERS
1 RELIEF
1 YEAR 24,480
5 YEARS 122,400
BULL GANG
6 MEN
1 YEAR 22,800
5 YEARS 114,000
TOTAL COST
PERVISION & LABOR
634,470 + 30% = 824,811
3,172,350 + 30% = 4,124,055
NOTE
THE 30% INCLUDES
A. 3.0% (AVERAGE) WORKMANS COMPENSATION
B. 5% PAYROLL TAXES (STATE & FEDERAL)
C. 5% VACATIONS & SICK LEAVE
D. 17% CONTINGENCY FUND
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MANGANESE RESEARCH FOR DEFENSE INC.
MANGANESE RESEARCH PLANT
ORGANIZATION CHART
DRAWN BY E. QUIAKE 11-5-54
E 100-0-2
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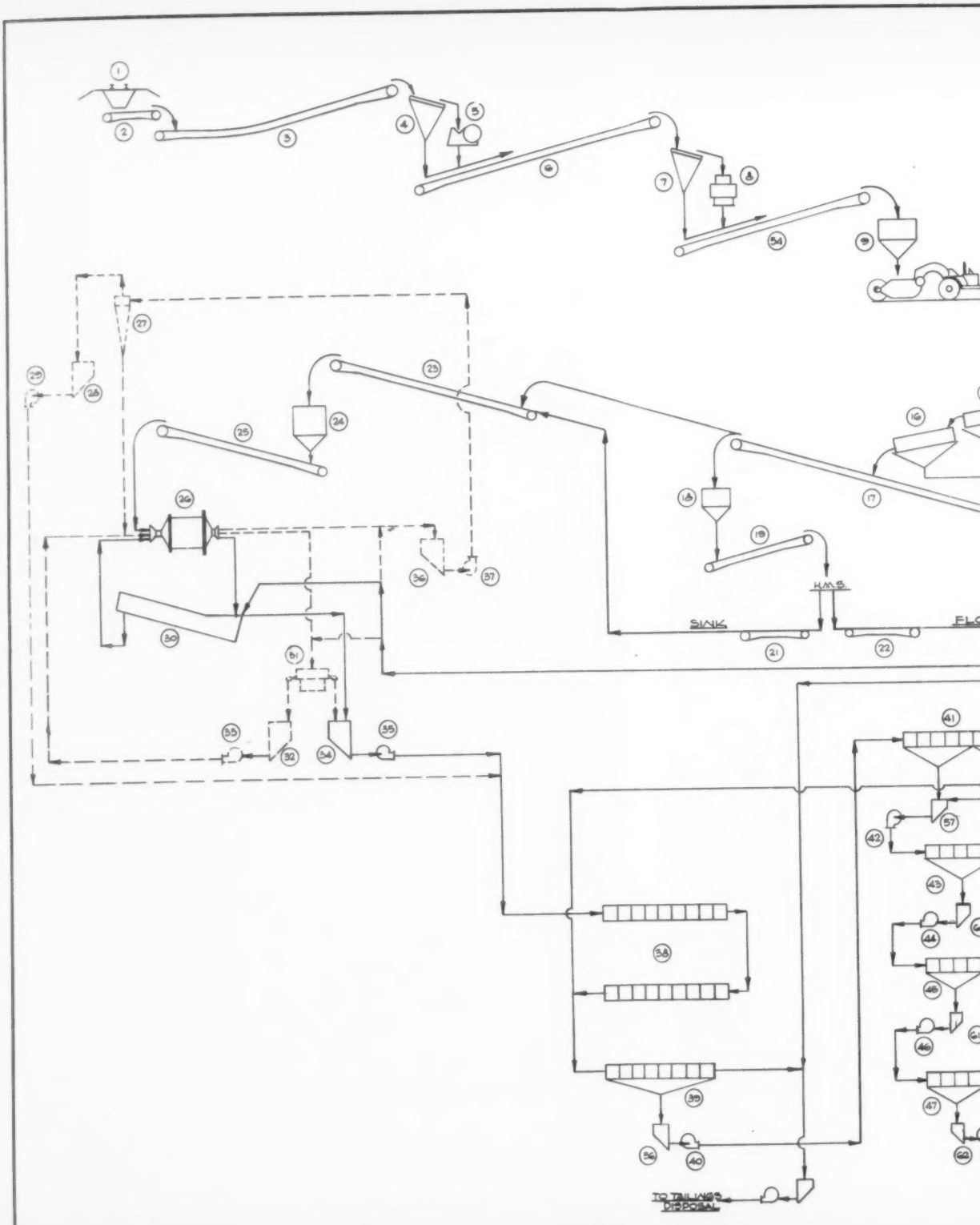
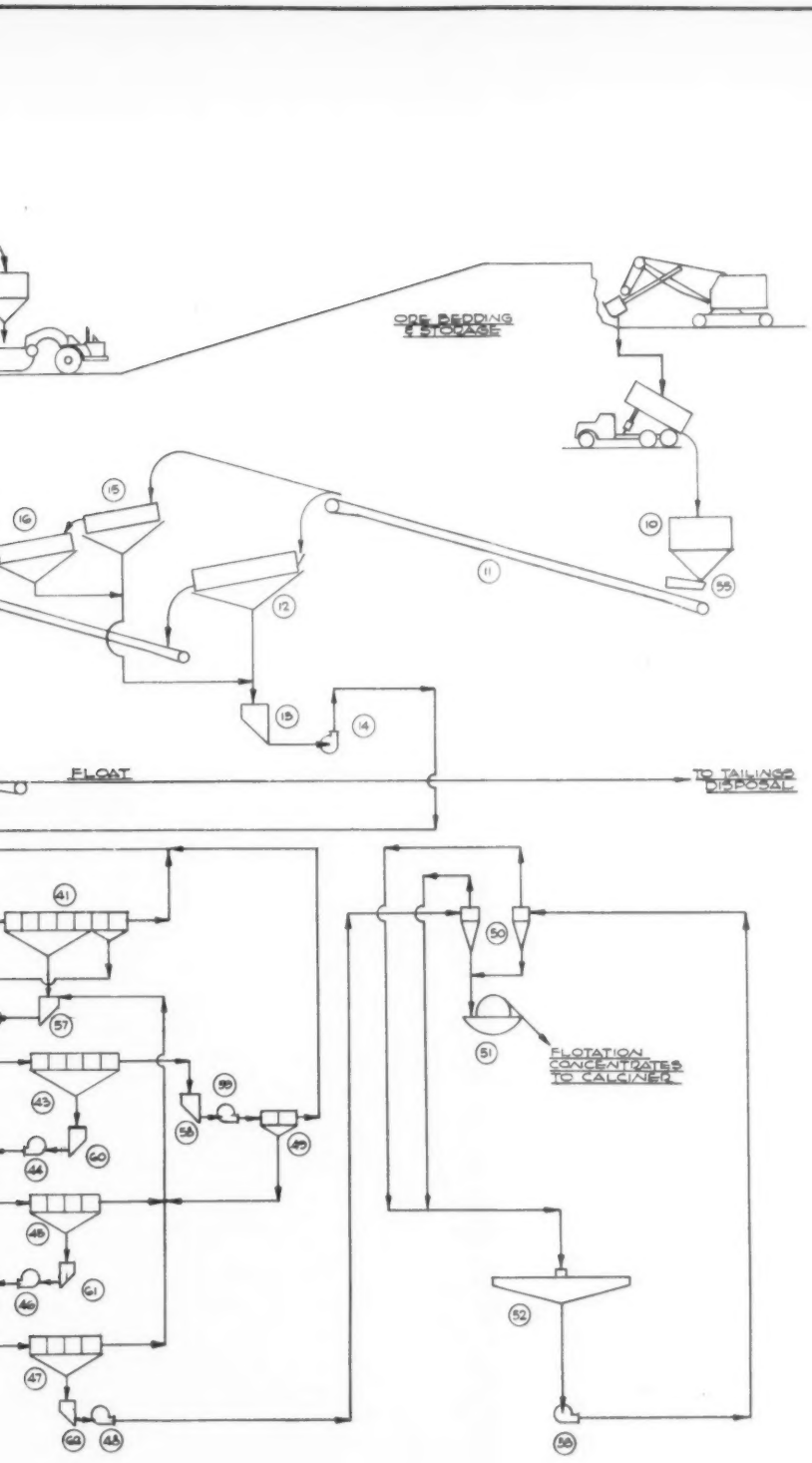

SINK
HMS
TO TAILINGS DISPOSAL



	EQUIPMENT	
(1)	TRACK HOPPER	
(2)	FEEDER	40 T/HR 5'x8'
(3)	BELT CONVEYOR	20"x 290'
(4)	GRIZZLY	5'x6' -2" MAT.
(5)	JAW CRUSHER	18"x 24"
(6)	BELT CONVEYOR	20"x 100'
(7)	GRIZZLY	5'x6' -1" MAT.
(8)	CONE CRUSHER	40 T/HR 3/8" (36S TELSMITH)
(9)	TRUCK HOPPER	14'x14'x14'
(10)	TRUCK HOPPER	12'x12'x8'
(11)	BELT CONVEYOR	20"x 100'
(12)	TROMMEL SCREEN	5'x 28'
(13)	SUMP	5'-6 x 5'-6 x 4'-6
(14)	PUMP	6" WILFLEY SAND
(15)	WASHING SCREEN	4'x 16'
(16)	DE-WATERING SCREEN	4'x 16'
(17)	BELT CONVEYOR	24"x 60'
(18)	SURGE BIN	8'x 20'
(19)	BELT CONVEYOR	20"x 54'
(20)	SWECO H.M.S. PLANT	30T/HR
(21)	BELT CONVEYOR	18"x 64'
(22)	BELT CONVEYOR	18"x 300'
(23)	BELT CONVEYOR	18"x 48'
(24)	SURGE BIN	10'x 20'
(25)	BELT CONVEYOR	18"x 22'
(26)	ROD MILL	5'x 12'
(27)	CYCLONE	12"
(28)	SUMP	3'x 3'x 4'
(29)	PUMP	4" WILFLEY SAND
(30)	CLASSIFIER	6'x 21'
(31)	SWECO SEPARATOR	
(32)	SUMP	3'x 3'x 4'
(33)	PUMP	4" WILFLEY SAND
(34)	SUMP	2'-6" x 2'-6" x 3'-6"
(35)	PUMP	3" WILFLEY SAND
(36)	SUMP	4'x 4'x 4'-6"
(37)	PUMP	5" WILFLEY SAND
(38)	CONDITIONERS	18-56"x56" FAG. FLOT CELLS
(39)	ROUGHERS	8-56"x56" FAG. FLOT. CELLS
(40)	PUMP	4" WILFLEY SAND
(41)	FIRST CLEANER	7-56"x56" FAG. FLOT. CELLS
(42)	PUMP	5" WILFLEY SAND
(43)	SECOND CLEANER	6-56"x56" FAG. FLOT. CELLS
(44)	PUMP	4" WILFLEY SAND
(45)	THIRD CLEANER	4-56"x56" FAG. FLOT CELLS
(46)	PUMP	4" WILFLEY SAND
(47)	FOURTH CLEANER	4-56"x56" FAG. FLOT CELLS
(48)	PUMP	4" WILFLEY SAND
(49)	MIDDLINGS CLEANER	2-56"x56" FAG. FLOT CELLS
(50)	CYCLONES	12"
(51)	DISC FILTERS	8'ø x 10
(52)	THICKENER	40'ø x 8'
(53)	PUMP	4" WILFLEY SAND
(54)	BELT CONVEYOR	20"x 110'
(55)	FEEDER	50 T/HR 18"x 48"
(56)	SUMP	4'x 4'x 5'
(57)	SUMP	6'x 6'x 7'
(58)	SUMP	4'x 4'x 5'
(59)	PUMP	4" WILFLEY SAND
(60)	SUMP	4'x 4'x 5'
(61)	SUMP	4'x 4'x 5'
(62)	SUMP	4'x 4'x 5'

NO.	BY	DATE	REVISIONS

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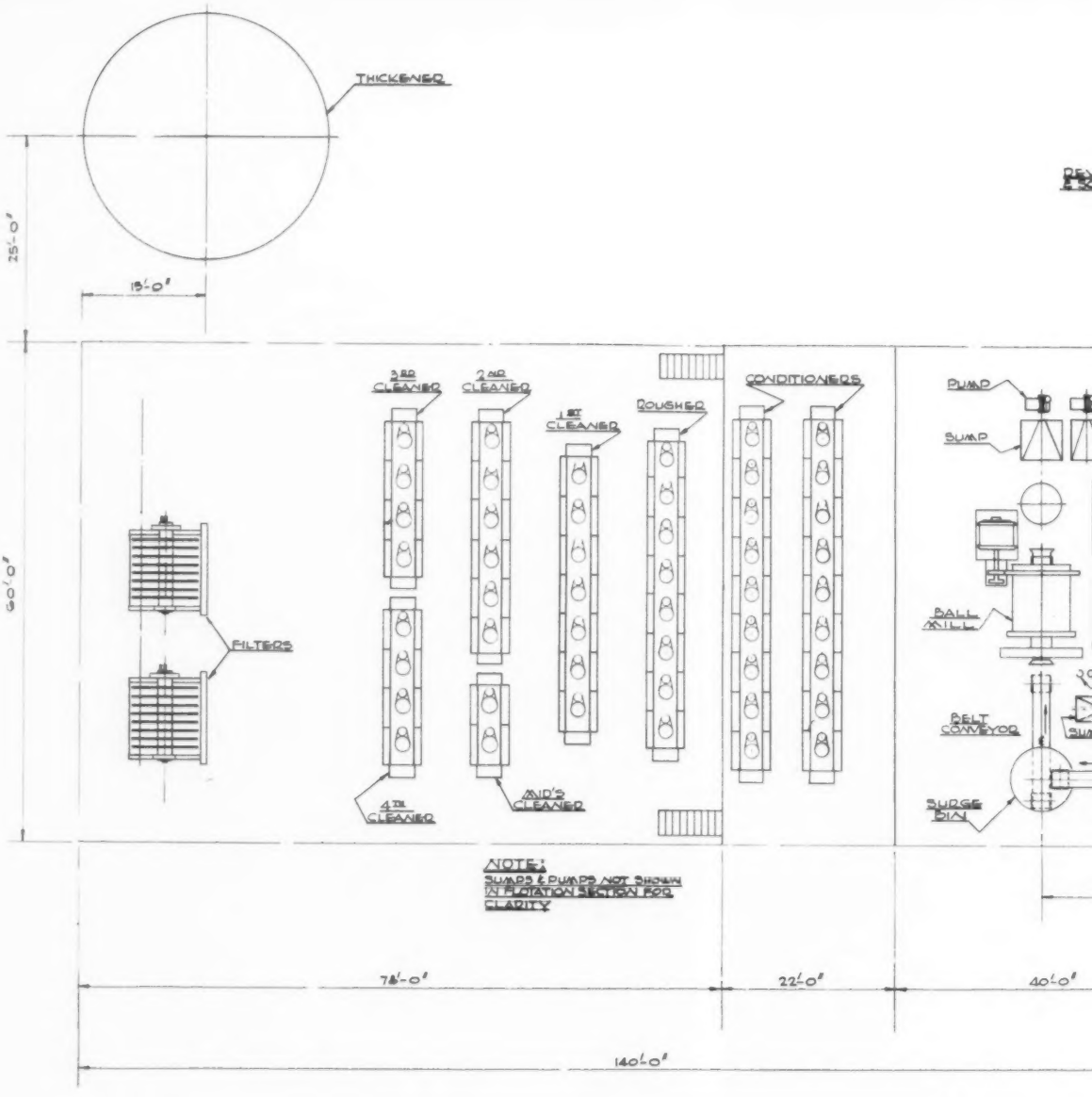
MANGANESE RESEARCH FOR DEFENSE INC.	SCALE	DATE
	DRAWN BY D. DACHEUX	11-1-54
MANGANESE RESEARCH PLANT	CHECKED BY	
	APPROVED BY	
CRUSHING & FLOTATION PLANT FLOWSHEET	AND DATE	
	E-1-0-1	REV.

X 922

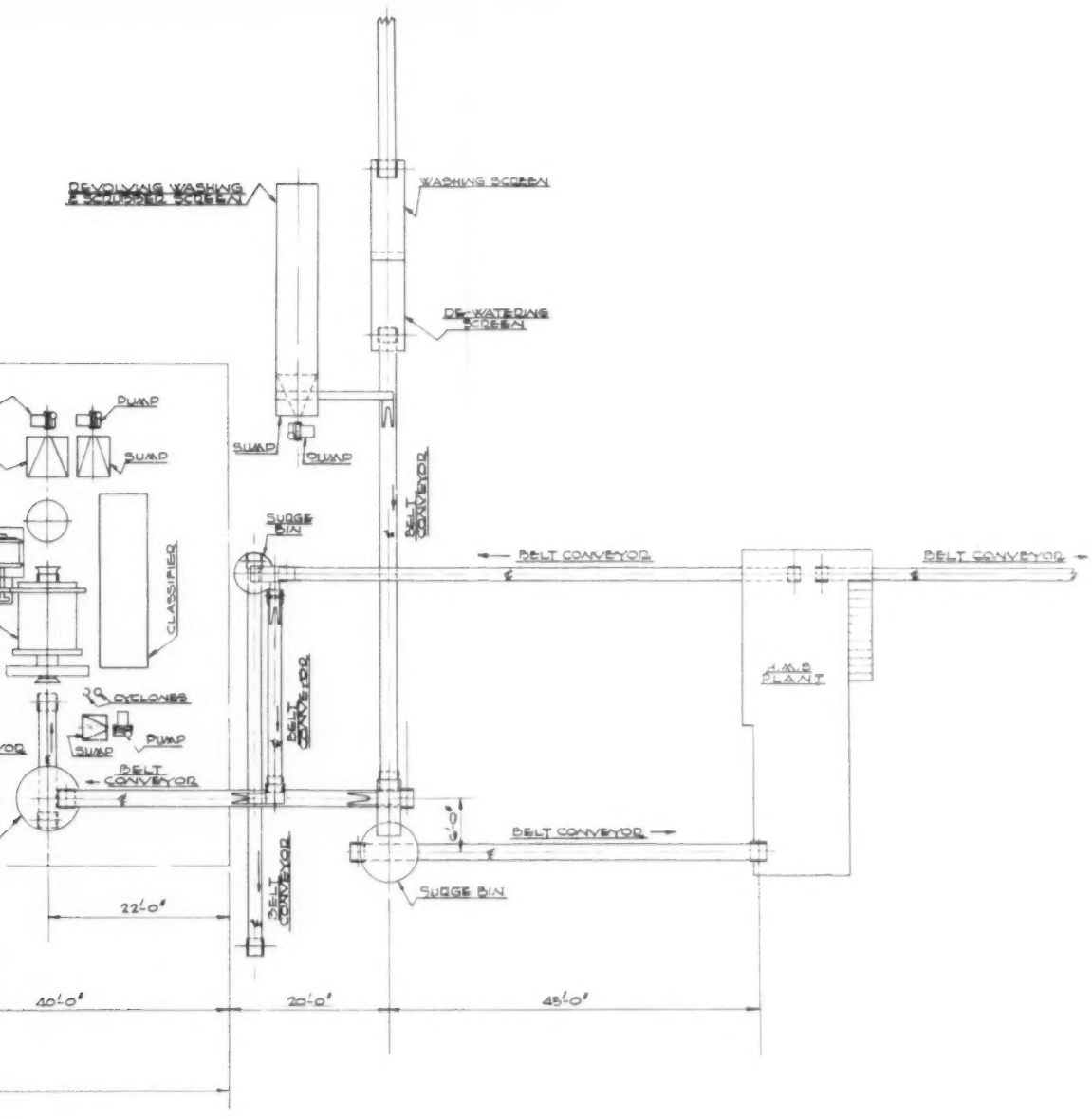


PLAN

GENERAL ARRANGEMENT

SCREENING, H.M.S., FINE GRINDING, FLOTATION & FIL

SCALE 1/8"-1'-0"



MENT
FLOTATION & FILTERING

X 922

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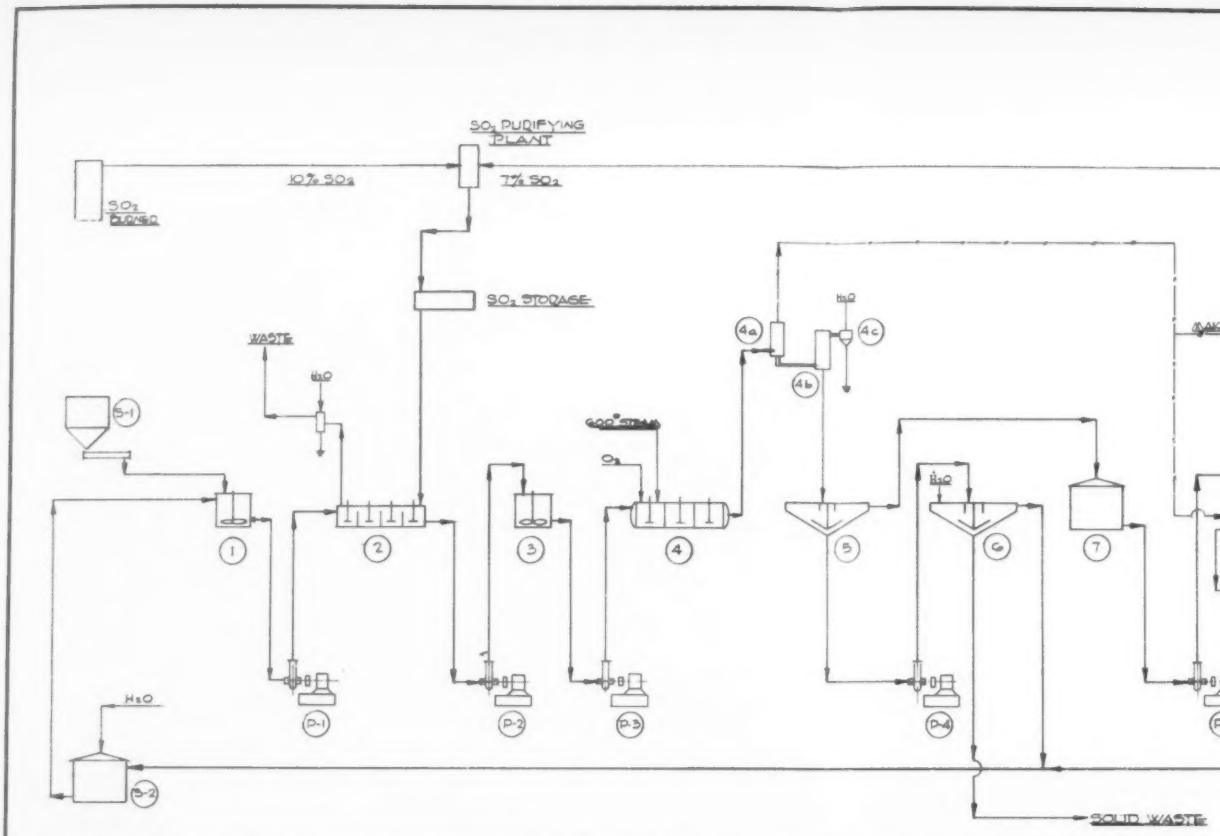
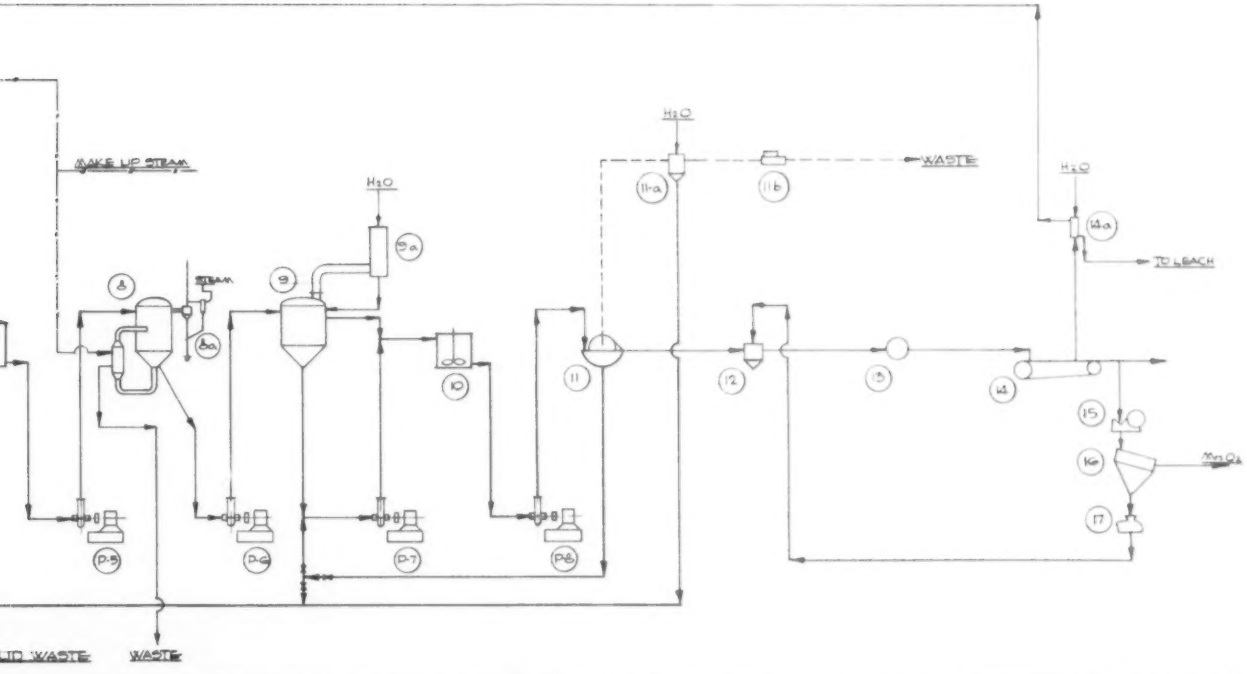
MANGANESE RESEARCH FOR DEFENSE INC.	SCALE	DATE
MANGANESE RESEARCH PLANT	DESIGNED BY	
GENERAL ARRANGEMENT MILL BUILDING	APPROVED BY	
	JOB NUMBER	E 2-11-1



ITEM NUMBER	1	2	3	4	4a	4b	4c	5	6	7	8	8a	9	9a	10	
ITEM NAME & CONDITION	MIX TANK	LEACH TANK	SURGE TANK	AUTOCLAVE	HIGH PRESSURE FLASH	LOW PRESSURE FLASH	STAGE STEAM EJECTOR	DECANTER THICKENER	COUNTER CURRENT WASH & SLURRY	SURGE TANK	EVAPORATOR	2 STAGE STEAM EJECTOR	CRYSTALLIZER	SCRUBBER	SURGE TANK	FI



	10	11	11a	11b	12	13	14	14a	15	16	17
	SURGE TANK	FILTER	SCRUBBER	VACUUM PUMP	CAKE STORAGE	PELLITIZER	D-L DRYER	SCRUBBER	JAW CRUSHER	3/4" SCREEN	HAMMER PULVERIZER

GENERAL NOTES

NO.	BY	DATE	REVISIONS

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MANGANESE RESEARCH FOR DEFENSE INC.

MANGANESE RESEARCH PLANT

CHEMMET PROCESS FLOWSHEET

DRAWN BY: D. DICKINSON 2-54

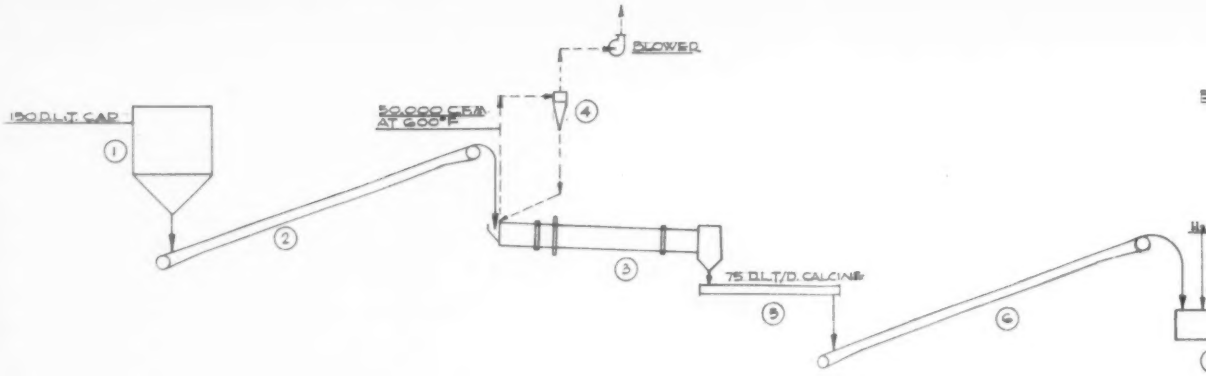
CHECKED BY:

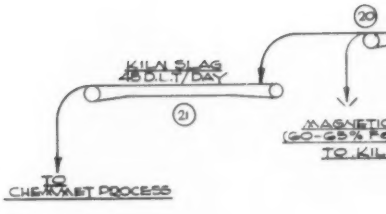
APPROVED BY:

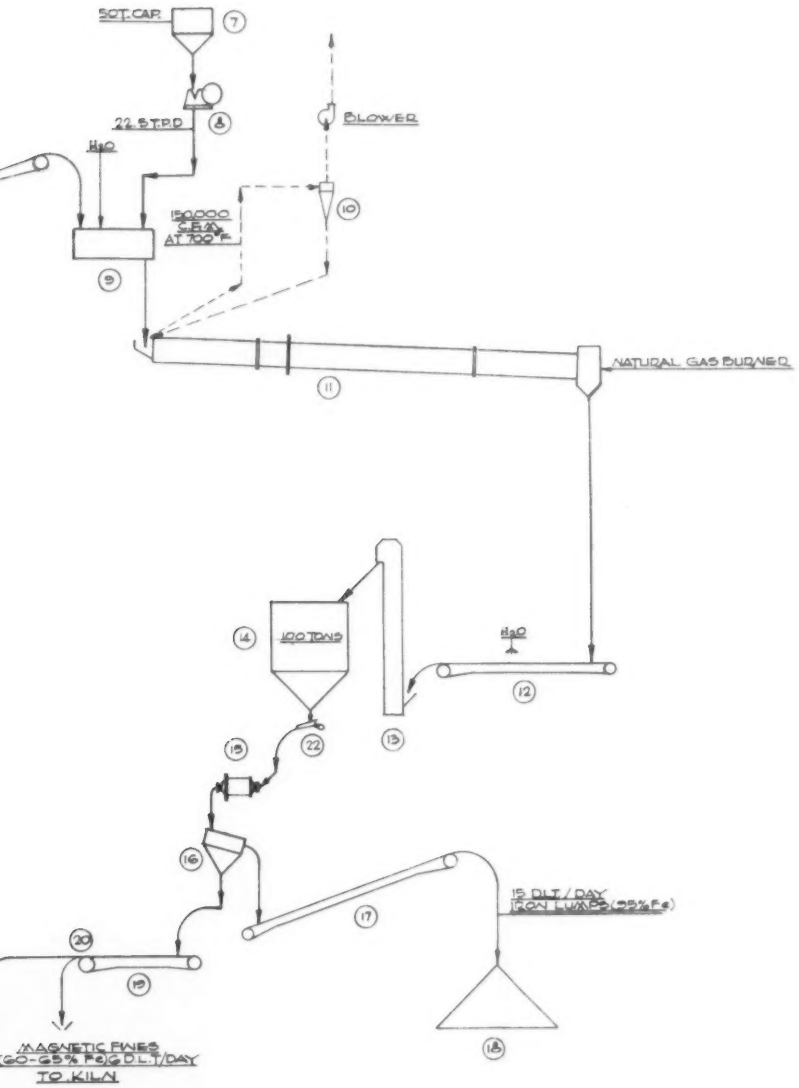
JOB NO.

E 3-0-1

X 222


BLOWER
150 D.L.T. CAR
①
50,000 CFM
AT 600°F
④
②
③
75 D.L.T/D. CALCINE
⑤
⑥


20
KILN SLAG
48 D.L.T/DAY
21
TO
CHEMMET PROCESS



	EQUIPMENT
1	FLOTATION CONC'T. STORAGE
2	CONVEYOR 18"x 250'LG.
3	CALCINING KILN 5'6"x 50'LG 40 HP
4	MULTICLONE DUST COLLECTOR 10 HP
5	HOLO-FLITE CALCINE COOLER 10 HP
6	CONVEYOR 18"x 150'LG 5 HP
7	COKE STORAGE 50 TON BIN
8	CRUSHER 5"x 6"
9	CALCINE & COKE MIXER 6'6"x 10'
10	MULTICLONE DUST COLLECTOR 10 HP
11	KILN 5'6"x 150'LG 85 HP
12	PAN CONVEYOR 18"x 20'
13	BUCKET ELEVATOR 35"x 11"x 35'
14	KILN SLAG STORAGE 100 TONS
15	BALL MILL 4'x 5'
16	VIBRATING SCREEN 18"x 2 HP
17	CONVEYOR
18	IRON LUMP STORAGE
19	CONVEYOR 16"x 50'LG. 5HP
20	MAGNETIC HEAD PULLEY
21	CONVEYOR 16"x 200'LG 5 HP
22	VIBRATING FEEDER 12"x 18"

GENERAL NOTES

NO.	BY	DATE	REVISIONS

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MANGANESE RESEARCH FOR DEFENSE INC.	SCALE	DATE
	DRAWN BY D.RACINE	11-1-54
MANGANESE RESEARCH PLANT	CHECKED BY	
	APPROVED BY	
KILN PROCESS FLOWSHEET	JOB NO.	
	E-40-1	REV.

X 322

PLANT NO. V

This plant is equipped for receiving, automatic weighing, and sampling of the finished product which is sintered manganese dioxide. Bin-over-track storage is provided for carload rail shipment.

Plant No. V—Sampling and finished product storage

1.0	Site clearance	$200
2.0	Earthwork	1,096
3.0	Concrete work	1,273
4.0	Steel construction	5,887
8.0	Electrical	3,707
9.0	Pipe work	1,436
11.0	Machinery and equipment	46,051
12.0	Instrumentation	1,424
	Total	61,074

PLANT NO. VI

Plant No. VI includes all the auxiliary facilities which consist of shops, offices, research development and analytical laboratories.

Plant No. VI—Administrative Area

1.0	Site clearance	$1,150
2.0	Earthwork	14,608
3.0	Concrete work	21,912
4.0	Steel construction	60,933
6.0	Other construction	2,435
7.0	Buildings	103,696
8.0	Electrical	42,082
9.0	Pipe work	24,346
11.0	Machinery and Equipment	52,664
12.0	Instrumentation	1,628
	Total	325,454

Mr. MORRIS. Yes, sir.
Mr. ADLERMAN. Thank you very much.
Mr. MORRIS. Thank you, sir.
Mr. ADLERMAN. Dr. Nossen.

STATEMENT OF DR. E. S. NOSSEN, VICE PRESIDENT, NOSSEN LABORATORIES, PATERSON, N. J.

Dr. NOSSEN. My name is Ernest S. Nossen.

Senator PAYNE. If I may, I would like to be given the privilege of introducing Dr. Nossen. It so happens that while serving as Governor of Maine, I became tremendously interested in the manganese deposits that exist in Aroostook County, and that have been recently considered by the Bureau of Mines on their latest report as containing perhaps one of, if not the largest deposits of manganese bearing ore in the country. One small area that is 5 square miles in content in the vicinity of Bridgewater, Maine, is estimated to contain better than 250 million tons of ore in that one particular spot. The extent of the deposits run from the area south of Houlton, Maine, up to and including an area north of Presque Isle, so it is difficult indeed to say what the total body may consist of, but it is figured it may approach a total tonnage in the vicinity of one billion tons of ore.

Dr. Nossen was brought into the picture while I served as Governor as a result of a study made by Dr. Gaudin of the Massachusetts

Institute of Technology, who was retained by me to evaluate the process that Dr. Nossen had worked on. Since that time I have been tremendously interested in the work that the Nossen Laboratories have conducted.

With that I will just simply say that I am pleased to have a chance to be here with Dr. Nossen, while he gives his testimony to the committee.

Mr. ADLERMAN. Thank you very much, Senator.

Dr. Nossen, will you state your qualifications?

Dr. NOSSEN. I am director of research of E. S. Nossen Laboratories, Inc., in Paterson, N. J., a research and development organization working in the field of chemistry and metallurgy, especially in the field of manganese.

I have prepared a brief statement, and I would like to read it to you and leave some copies for the record.

Mr. ADLERMAN. We would be glad to have it.

Dr. NOSSEN. I am a director and vice president of E. S. Nossen Laboratories, Inc., a research and development organization in the field of metallurgy. I am a chemical engineer with 25 years' research and industrial experience in the chemical, electrochemical and metallurgical field especially in the field of manganese and its compounds. I was technical director of "Eltax" Berlin and Copenhagen (1932–35), technical director of AIME (N. V. Algemeene Industrieele, Mijnbouw-en Exploitatiemaatschappij) Amsterdam (1936–48) and member of the research staff of Activit, subsidiary of Royal Sulfuric Acid Corp., Amsterdam (1940–48). In addition to that work I acted during the years 1947–48 as consultant to the Dutch Government and the Army.

Four years ago, when I disclosed the nitric acid cycle for the concentration of manganese to the American Chemical Society, I stated that the larger low-grade manganese deposits in the United States will require chemical processes for their beneficiation. In the meantime much experimental work has been done to handle these ores with classical ore dressing methods or modern physical methods like sink and float or flotation processes. It has been proven by these tests that physical methods are not applicable to these low-grade deposits and that it is very doubtful whether the materials in the stockpiles in Deming and Wenden can be handled by physical methods with a satisfactory manganese recovery, the more as these stockpiles contain a mixture of ores of quite different character.

Chemical processes are applied in the recovery of other metals like copper and nickel on a large scale. However, those economically applied for copper, nickel and cobalt are in most cases uneconomical when applied to manganese, since the value of manganese per pound in concentrates amounts to only a fraction of the value of the other metals. Therefore, cost for chemicals and their losses must be reduced to an absolute minimum. I have studied and applied on industrial scale for 20 years chemical processes for handling manganese ores. In these studies were included all the chemical processes known up to now, and the result was the development of the nitric acid cycle.

BENEFICIATION OF MANGANESE ORES

This process is very simple, since no undesirable side reactions take place. The reactions run to completion in a few minutes in each of the three basic steps. The basic steps are:

1. Leaching of the ore with diluted nitric acid, whereby manganese and lime go into solution.

2. Separation of the leach solution from the solid gangue material containing the oxides of aluminum and iron, phosphorus, silica and other materials, which are not desired in the manganese concentrate, but can be recovered separately.

3. Decomposition of the leach solution into the desired solid manganese concentrate and the nitric acid, which is used over and over again with fresh ore.

Additional steps are the same as in flotation and in any chemical process: crushing and grinding the ore, a reducing roast in some of the ores, and nodulizing the manganese concentrate. The process does not require complicated or unusual operation conditions such as high temperatures and high pressures. No reactions difficult to control, no accumulation of impurities takes place in the cycle, since the leaching agent nitric acid is recovered by distillation. During 5 years' work on this process at different scale, no corrosion problem has been encountered. The process has been applied at bench scale with a few pounds of ore treated at a time, at a small pilot-plant scale handling 50 pounds per hour, and recently at a large pilot-plant scale handling 1,000 pounds per hour. No changes in degree of extraction, composition of the manganese concentrate or nitric acid recovery have been encountered under these different conditions in size of equipment. Ores from the stockpile in Deming have been treated with a manganese recovery of 95 percent, nodules from Chamberlain, S. Dak., with an average recovery of 75 percent, ores from the Cuyuna Range (Minn.), with a manganese recovery of 86 percent, and ores from Aroostook County, Maine, with a manganese recovery of 80 percent (Castle Hill).

The composition of the product resulting from Maine ores is as follows:

		Fe_2O_3		CaO	2.9%	H_2O	2.8%
Mn:	56.5%	Al_2O_3	0.0%	MgO	3.48%	P_2O_5	0.0%
Mn-oxides	88%	SiO_2		Na_2O	0.98%	N_2O_5	0.65%

For metallurgical purposes:

		Fe_2O_3		CaO	17.5%	H_2O	
Mn:	48.7%	Al_2O_3	0.0%	MgO	4.2%	P_2O_5	0.0%
Mn-oxides	74.2%	SiO_2		Na_2O	4.1%	N_2O_5	

Ores from Aroostook County have been tested in a pilot plant built and operated by Nossen Laboratories in 1954 under contract with DMPA. The project was financed by Government funds. Results obtained at a smaller rate have been fully confirmed in this plant and the general opinion of scientists and engineers of the Government and independent research organizations, who have been close to the pilot

plant work or prior demonstrations of the Nossen process, is that the metallurgy of the new process was proven to be technically sound. Certain difficulties were encountered in connection with mechnical operations of some of the equipment which have not been completely overcome during the period of the contract.

In the meantime, however, continued cooperation between Nossen Laboratories and equipment manufacturers has solved these problems. Simultaneously, a continuous leaching procedure instead of batch leaches has been developed and a substantial shortcut in the finishing of the manganese concentrate leaving the decomposition unit.

THE ECONOMICS

A complete plant layout for a commercial plant producing 100 tons of concentrate a day was developed. The cost for the plant was determined in cooperation with equipment manufacturers, builders, et cetera.

The processing cost per ton concentrate or per unit manganese was derived from actual pilot plant work to be 80 cents per unit manganese produced. This amount is broken down in four almost equal parts for:

1. Chemicals.
2. Utilities (fuel, power, water).
3. Labor and supervision.
4. Depreciation of the plant, maintenance cost, taxes, et cetera.

(Indirect cost as overhead, royalties, research, and profit are not included. The ore is not included, either.)

It appeared that the cost for makeup nitric acid is less than a penny per pound manganese, and this amount can be cut by 50 percent when a large enough production of manganese concentrates justifies a nitric acid plant combined with the manganese plant.

Independent from our calculation two research organizations confirmed the figures obtained by us. One of them made a study of 11 chemical processes for manganese concentration and recommended the Nossen-nitric-acid cycle as the most feasible and economical of all the processes under investigation.

Therefore, we felt justified to make the following recommendations in our final report on the pilot plant operation to GSA:

It is recommended that commercial-size production capacity be established:
A. For the beneficiation of low grade ores already stored in existing Government stockpiles.
B. For the beneficiation and stockpiling of manganese ore mined in Aroostook County, State of Maine.

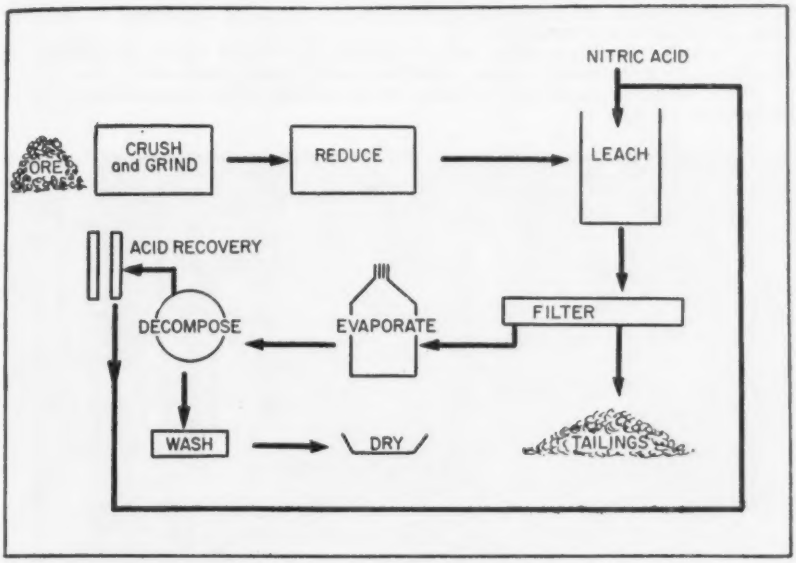
Mr. ADLERMAN. Thank you. I notice that you have attached to your memorandum a reprint from the Chemical and Engineering News.

Dr. NOSSEN. Yes, sir.

Mr. ADLERMAN. I would like to put that in the record, too.

(The document referred to follows:)

[Reprinted from Chemical and Engineering News, vol. 32, November 1, 1954]



MANGANESE—OFF THE CRITICAL LIST?

NEW ORE CONCENTRATION PROCESS USES DOMESTIC SUPPLIES FROM MAINE, MAY FREE UNITED STATES FOREIGN SOURCES

Critical manganese may get a boost from a new concentration process pilot-planted in Paterson, N. J. At the rate of 1,000 pounds of ore every hour, plant produces a concentrate containing 60 percent manganese, recovering 80 percent of the metal from low-grade ores available in the United States. Pilot plant has been operating all summer; concentrate gives every indication of competing successfully with imported high-grade ores.

About 90 percent of United States manganese ore is imported from India, Africa, South America, even Russia. Every ton of steel produced requires 13 pounds of manganese; annual United States steel industry consumption approximates 1.5 million short tons manganese ore averaging 48 percent manganese.

Chemical, dry-cell battery, other industries use another 80,000 to 100,000 tons of ore (85 percent manganese dioxide plus special purity requirements).

Today, with steel operating below capacity, some imported manganese ore is being stockpiled.

United States manganese deposits are uniformly low grade (5 to 20 percent manganese); are sufficient for a century or longer if developed. Marketable concentration is 40 percent, not within reach with classical physical ore dressing methods which can strain from 20 to 25 percent.

New method, developed by Ernest S. Nossen and pilot-planted by E. S. Nossen Laboratories, utilizes a nitric acid cycle, can produce salsable iron, calcium nitrate fertilizer as byproducts.

Process separates manganese from silica, other undesirable impurities including iron. Nitric acid can be recovered at better than 95 percent, an essential step which makes process economic.

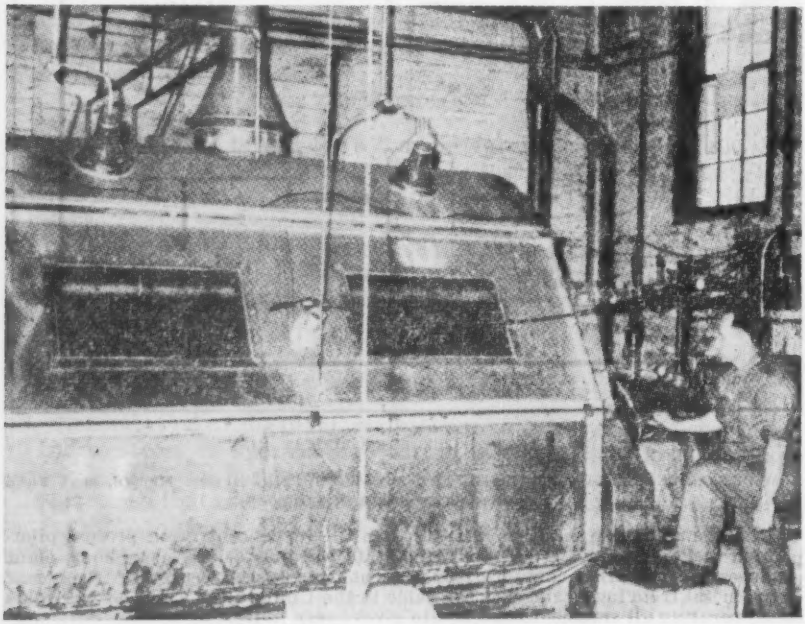
Use of Maine ore: Raw material for Paterson pilot plant is low-grade ore from Aroostook County, Maine, running about 10 to 12 percent manganese. It contains large amounts of calcium oxide, iron oxide, silica, so intimately mixed that ore has always been considered useless.

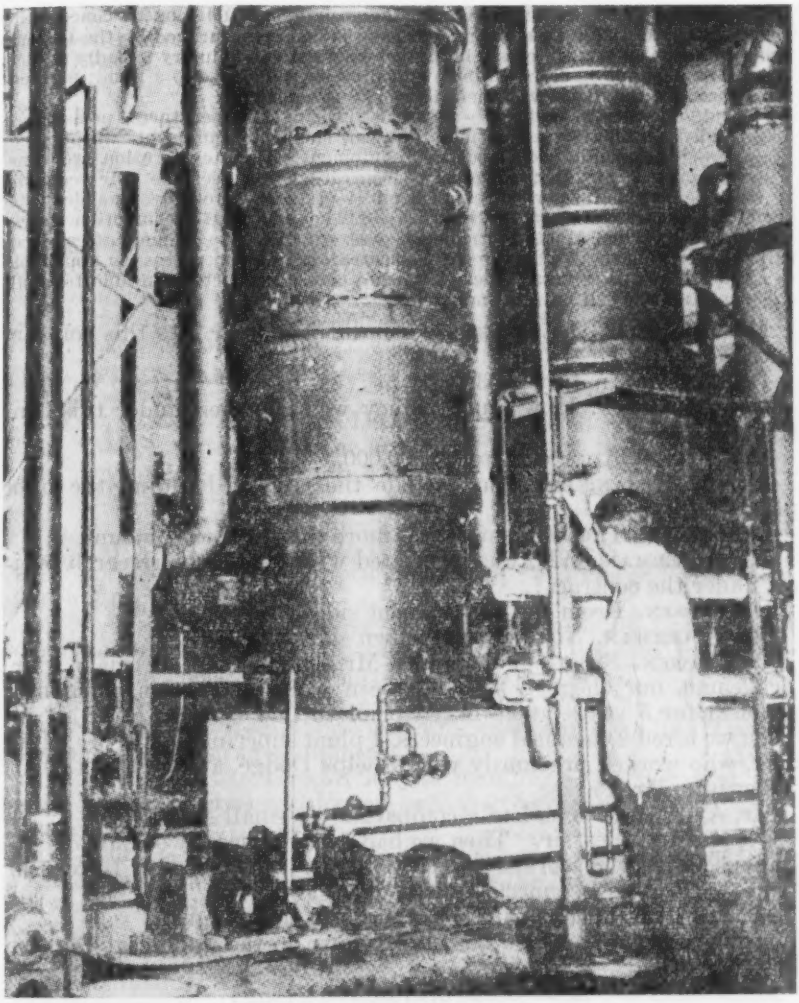
Local ore variations may require small changes in treatment of each batch.

Ore, in 4,000-pound batches, is crushed and ground to —60 mesh. In a multiple-hearth furnace, between 600° and 900° C., it is reduced in a reducing atmosphere formed by incomplete combustion of city gas. Manganese dioxide

goes to the monoxide, iron oxide goes to ferrosoferric oxide. Mixture is then leached with nitric acid diluted with wash water from previous batches. Nitric acid concentration in leach is 20 to 25 percent; when ore is present actual free acid concentration is lowered.

Insoluble ferrosoferric oxide, silicon dioxide, aluminum oxide are filtered off from soluble manganese nitrate, alkaline earth salts. Reduction step is not necessary when manganese is present in ore as monoxide or carbonate, as in Maine ore.





If the ore contains relatively little calcium, sulfuric acid is used to precipitate calcium, barium, and lead. Where large quantities of calcium are present it is more economical to skip this step and recover calcium nitrate for fertilizer applications. Most ore deposits are convenient to fertilizer markets, an advantage which might warrant installation of nitric acid manufacturing facilities.

Residue is washed for maximum recovery of soluble manganese; solution is concentrated from about 40 to 70 percent solids in an evaporator. Decomposition directly to manganese dioxide and nitric acid is carried out in a drum decomposer in presence of steam and air at about 200° C. Dioxide is washed; if sulfuric precipitation of alkaline earth nitrates has been skipped, earth nitrates are washed out and recovered. In a full-scale production plant vacuum filters would be replaced by countercurrent thickeners.

Nitric acid vapors and some oxides of nitrogen from the drum decomposer are recovered by a condenser and absorption system. Iron can be salvaged by magnetic separation.

Break-even at 100 tons: Break-even point is about 100 tons of concentrate per day, or 600 to 700 tons of ore. Process is being encouraged by the Government and also by local interests in Maine, where stable industry is badly needed. Unnecessary handling costs can be avoided by locating close to a mine; markets for byproduct fertilizer will then also be convenient.

Difficult operating conditions—gas reactions, high temperatures, pressures—are avoided; standard mining, metallurgical, chemical equipment can be used. Stainless steel leaching, decomposition equipment eliminate corrosion problems.

Pyrometallurgical, other chemical concentration processes are only economic in extreme national emergencies. Chemical processes are only feasible when chemicals are recovered (as in this case) or when chemical consumption is negligible (as in case of Montana carbonate ores, which can be calcined after physical concentration to give 60 percent concentrate). Nossen process is applicable to carbonate, oxide, several types of silicate ores. Product is suitable for both chemical and dry cell battery industries.

Mr. ADLERMAN. Dr. Nossen, when did you enter into this contract with GSA?

Dr. NOSSEN. In July 1953.

Mr. ADLERMAN. How much money was allocated under this contract?

Dr. NOSSEN. Approximately $500,000.

Mr. ADLERMAN. Did that include the cost of building the pilot plant?

Dr. NOSSEN. That is right, it was more than half the amount.

Mr. ADLERMAN. Who was associated with you in the research project under the contract?

Dr. NOSSEN. From the Government side?

Mr. ADLERMAN. No; from your own side.

Dr. NOSSEN. From our own side, Mr. Thomas, my associate. Mr. Triffleman, our chemist, who has been working on this manganese problem for 5 years, and worked prior to that time with Dr. Dean. Then we hired 2 chemical engineers, 1 plant superintendent, Mr. Haybeck, who worked previously with Phelps Dodge, and assistant plant supervisor, Mr. Parks.

Mr. ADLERMAN. You had a comparatively small staff.

Dr. NOSSEN. Yes, sir. Then we had for analytical work an analytical specialist who worked for 15 years for the Canadian Bureau of Mines. He is now connected with our organization.

Mr. ADLERMAN. When did you close down that plant?

Dr. NOSSEN. This plant was closed down in the middle of October 1954.

Mr. ADLERMAN. After it had operated how long?

Dr. NOSSEN. We started with the shakedown of the equipment in April 1954, but the plant was only completed at the end of June 1954. While we were still in the stage of construction we started with the shakedown of some of the first steps.

Mr. ADLERMAN. How long were you actually able to operate the pilot plant?

Dr. NOSSEN. Actually between July and the middle of October.

Mr. ADLERMAN. About 3½ months.

Dr. NOSSEN. About 3½ months.

Mr. ADLERMAN. Did you feel that was sufficient time?

Dr. NOSSEN. Actually not. We applied in August for an extension of the contract for 3 or 4 months, and we were supported in this by the Bureau of Mines, Mr. Conley, and his associates, who observed and monitored our operations. They were attached to our plant for a period of 3 weeks for testing of the several unit operations.

Mr. ADLERMAN. You were unable to continue after 3½ months because the money ran out?

Dr. NOSSEN. That is right, the contract expired.

Mr. ADLERMAN. Are you under negotiation now?

Dr. NOSSEN. Yes. It is the intention of the GSA to continue the pilot plant work.

Mr. ADLERMAN. Do you feel that you progressed far enough to recommend a large-scale plant now?

Dr. NOSSEN. I would say yes. In the engineering work for which we would take more time than is usually required, we would incorporate some pilot plant work in certain phases concurrently with the work of the engineers.

Mr. ADLERMAN. Are you able to venture any estimates of what the ultimate cost of the manganese would be of a usable commercial grade, using your process?

Dr. NOSSEN. Yes.

Mr. ADLERMAN. And on the Deming deposits?

Dr. NOSSEN. Based on Maine ore, it will amount to $1.70 per unit.

Mr. ADLERMAN. That is quite a bit less?

Dr. NOSSEN. Yes.

Mr. ADLERMAN. That includes the cost of the ore?

Dr. NOSSEN. That includes the cost of the ore.

Mr. ADLERMAN. You feel optimistic about the successful operation of such a project?

Dr. NOSSEN. Definitely. Every time we stepped it up from several pounds to 50 pounds to 1000 pounds, we did not not find any deviations as far as chemistry and metallurgy are concerned.

Mr. ADLERMAN. The results were uniform?

Dr. NOSSEN. The results were uniform. Of course, we had troubles sometimes in adjusting equipment.

Mr. ADLERMAN. As I recall it, you mentioned the fact that two research organizations had looked over your progress.

Dr. NOSSEN. Yes.

Mr. ADLERMAN. Will you name those research organizations?

Dr. NOSSEN. Yes. Arthur DeLittle, and the Vitro Corp.

Mr. ADLERMAN. Were they employed by the Government to do that?

Dr. NOSSEN. No, they were not employed by the Government.

Mr. ADLERMAN. You had them do it yourself?

Dr. NOSSEN. Yes. We were interested from other sources. Vitro at once had the intention of going into this business eventually, and Arthur DeLittle was interested.

Mr. ADLERMAN. Has the Government assigned anybody to make a check?

Dr. NOSSEN. Yes, the Bureau of Mines, as I told you before.

Mr. ADLERMAN. That was Mr. Conley.

Dr. NOSSEN. Yes.

Mr. ADLERMAN. Is Mr. Conley here?

Mr. CONLEY. Yes, sir.

Mr. ADLERMAN. Would you step up here and sit down, please?

Mr. CONLEY. Yes, sir.

Mr. ADLERMAN. Mr. Conley, would you state briefly for the record your full name and your title in the Bureau of Mines?

STATEMENT OF JOHN E. CONLEY, SUPERVISING CHEMICAL ENGINEER, AND CHIEF, MINERALS PROCESSING BRANCH, EASTERN EXPERIMENT STATION, BUREAU OF MINES, COLLEGE PARK, MD.

Mr. CONLEY. My name is John E. Conley, Supervising Chemical Engineer and Chief of the Minerals Processing Branch at College Park, Md., Eastern Experiment Station of the Bureau.

Mr. ADLERMAN. Mr. Conley, you were assigned by the Bureau of Mines to investigate the possibilities of the Nossen process?

Mr. CONLEY. We were requested by GSA to monitor this operation. In that capacity I made numerous visits to Paterson while the pilot plant was in operation.

Mr. ADLERMAN. Would you mind just stating briefly for the record what your observations were?

Mr. CONLEY. I should say to begin with that I think that the process is technically feasible. It has many things to recommend it as a means of processing low-grade ores, which are not amenable to beneficiation by physical or mechanical methods.

I feel, and I have so stated in the reports, that the pilot-plant operations at Paterson have not been completed to the point where we can evaluate the process sufficiently to translate the experimental results to a commercial size unit. In other words, I would recommend that additional work be done to complete the tests and to acquire additional operating data, particularly data on the recovery of nitric acid. This is necessary before we can arrive at a reliable idea of the possibility of the nitric acid process.

Mr. ADLERMAN. In other words, you feel that the 3½ months' operation was far too short?

Mr. CONLEY. Yes, definitely. They were plagued with the usual difficulties which interfere with the operation of pilot plants. Delivery of equipment was behind schedule, and neither the Nossen Co. nor GSA was responsible for that. The equipment manufacturers failed to deliver the equipment as promised. There were unavoidable delays for that reason.

Mr. ADLERMAN. You feel that the company should be given further money to carry on the reasearch?

Mr. CONLEY. I would prefer to say that additional research should be carried out. I don't believe that I would specify who should continue that work. I think that the experiments should be continued and completed. Additional money should be provided to obtain the engineering data which is essential before you could translate the results to a commercial plant.

Mr. ADLERMAN. Who owns the plant now?

Mr. CONLEY. I think it has reverted to GSA, and is in standby condition.

Mr. HOLDERER. Have any estimates been made of the size and cost of the next size plant, the pilot plant, for example? I understand that the 1,000-pound batch tests were the largest you worked with, Doctor.

Dr. NOSSEN. No; 4 to 5 thousand pounds. The average input through the total plant was 1,000 pounds per hour and the tests took about 4 hours.

Mr. HOLDERER. Did anyone make an estimate of a 50- or 100-ton plant?

Dr. NOSSEN. Yes.

Mr. HOLDERER. You have those estimates?

Dr. NOSSEN. Yes, sir; they are contained in our report.

Mr. HOLDERER. Let us have those in a supplement to your testimony.

Mr. ADLERMAN. You can furnish that to us at a later time. You have made those estimates.

Dr. NOSSEN. Yes.

(The estimates are as follows:)

Processing cost

Production—100 tons per day MnO_2 product (56.5 percent)
Operation—330 days per year
Investment—$1,750,000

Item	Units	Cost per unit	Units per day	Cost per day	Cost per ton product
1. Raw material:					
Nitric acid	Tons	$72.00	14	$1,005.00	$10.05
Makeup	68 percent acid	5.00	7.65	38.20	.38
Limestone	Tons	5.00	7.65	38.20	.38
2. Utilities:					
Power	Kilowatt-hours	.011	19,700	217.00	2.17
Fuel	106 B. t. u.'s	.493	1,625	792.00	7.92
Water	1,000 gallons	.05	661	33.00	.33
3. Labor:					
Operators	Man-hours	1.90	136	297.00	[1] 2.97
Helpers	do	1.35	144	223.00	[1] 2.23
Maintenance	do	1.75	96	193.00	[1] 1.93
4. Plant management: Supervision, quality control, monthly payroll.				196.00	1.96
5. Maintenance supplies: 50 percent maintenance labor				97.00	.97
6. Depreciation: 10 percent investment				530.00	5.30
7. Taxes and insurance: 2 percent investment				106.00	1.06
					37.27
8. Operating contingency, 10 percent					3.73
Processing cost for 1,130 pounds manganese, total					41.00
Per unit (22.4 pounds)		$0.814			
Cost for ore delivered at plant in Maine (cost seaboard) per unit recovered.		.50			
Overhead		.26			
		1.574			
Profit before taxes		.315			
Price for concentrate per unit f. o. b. plant		1.889			

[1] Daily cost includes 11 percent payroll burden over hourly rates. Plus 4 percent for adjustment to annual basis.

Cost for a plant to produce 100 tons manganese concentrate a day—equipment cost, installed

1	Power crane	$34,000
1	Raw ore bin	5,000
1	Drag conveyor	4,000
1	Size reduction equipment— 1. 2 stage crushing with conveyor 2. Mills with screens 3. Elevators	135,000
1	Crushed ore bin	3,500
1	Screw feeder	1,500
1	Belt feeder with tripper	11,500
7	8,000 gallon agitated leach tanks	70,000
3	Slurry pumps	3,500
1	Water heater steam storage tank	2,000

Cost for a plant to produce 100 tons manganese concentrate a day—equipment cost, installed—Continued

1	Solid-liquor separation equipment	$120,000
1	Surge tank, leach reservoir	5,000
1	Evaporator feed pump	600
1	Preheater	4,500
1	Double effect evaporator	46,000
1	Surge tank	3,600
1	Decomposition feed pump	600
7	Double roll decomposition units, twin roll 5 x 12 feet	240,000
2	Condensers	15,000
4	Acid towers including scrubber	30,000
5	Acid pumps	2,500
4	Acid coolers	2,400
1	Conveyor and elevator setup	7,500
1	Pebble mill	15,000
1	Surge tank, agitated	2,000
2	Slurry pumps	1,200
2	Rotary vacuum filters	65,000
1	Rotary dryer	35,000
2	HNO_3 storage tanks, 15,000 gallons each	15,000
1	HNO_3 feed pump	700
3	Boilers, package type	135,000
Miscellaneous		33,400
	Total	1,050,000

PLANT COST

Installed equipment	1,050,000
Piping, estimated, material and labor 4x pilot-plant cost	160,000
Electrical material and labor 5x pilot plant cost	75,000
Instrumentation	25,000
Auxiliary facilities, office, laboratory 3,000 square feet	35,000
Building (including architecture and engineering) 12,000 square feet at $11	135,000
Site preparation and railroad siding (including engineering)	30,000
Engineering	80,000
	1,590,000
Contingency—10 percent	159,000
	1,749,000
For mining equipment	251,000
Total investment	2,000,000

Mr. HOLDERER. Mr. Conley, you would be in favor of continuing work on this process?

Mr. CONLEY. Definitely.

Mr. HOLDERER. Would the next step in your opinion be a pilot plant, whatever the tonnage may be? In other words, a tonnage pilot plant without specifying the tonnage? Would that be the next step for more work on what you have there?

Mr. CONLEY. In my opinion the present pilot plant is sufficiently large to develop.

Mr. HOLDERER. And it could be expanded to take care of a larger tonnage?

Mr. CONLEY. No, I would not say that. The plant was designed to treat between 12 and 14 tons a day of Aroostook County, Maine, manganese ore.

Mr. HOLDERER. But they only treated about 5,000 pounds.

Dr. NOSSEN. In each leach, not per day.

Mr. CONLEY. That is correct, 1,000 pounds an hour would be 12 tons a day. On that scale, they had their problems and plenty of them.

Mr. HOLDERER. That is still a batch process as it stands now?

Dr. NOSSEN. No. As it stands, it is the end of our contract. In the meantime we have developed——

Mr. HOLDERER. Some additional equipment would make it continuous?

Dr. NOSSEN. Yes, sir.

Mr. CONLEY. Perhaps I should make myself clear. I don't know whether I have or not. It should not be implied that I would object to Dr. Nossen continuing the tests. I think that would be a logical solution of the problem. At least, whatever disposition is made of the plant, and whatever plans are made, if there are any, for continuing those tests, I think Dr. Nossen and his organization should be closely associated with those operations.

Mr. ADLERMAN. I take it, then, that as far as the scientific work is concerned, you feel Dr. Nossen is well qualified to handle it?

Mr. CONLEY. Yes.

Mr. ADLERMAN. And he should continue on with that work. The question may be of the administration's attitude.

Mr. CONLEY. I would say that would be largely the situation.

Mr. ADLERMAN. The administrative problems should be divorced from the technical problems of research.

Mr. CONLEY. I would go along with that conclusion.

Mr. ADLERMAN. If there are no further questions, thank you very much, Doctor.

Dr. NOSSEN. Thank you, sir.

Mr. ADLERMAN. Mr. Sims, please. Will you state your full name and your title and connections for the record.

STATEMENT OF IVOR SIMS, PURCHASING AGENT, BETHLEHEM STEEL CO., BETHLEHEM, PA.

Mr. SIMS. My name is Ivor Sims, I am purchasing agent of the Bethlehem Steel Co., Bethlehem.

Mr. ADLERMAN. Mr. Sims, we, as you know, are very much interested in the manganese situation and the question of determining whether or not we will have manganese during a wartime emergency. Without going into too much detail it seems pretty clear that we will not be able to procure manganese from abroad during an emergency, and therefore we have to develop our domestic resources as far as possible. Can you tell us what your company has done on the manganese situation?

Mr. SIMS. We are very much interested in manganese ore from two standpoints. First, as a producer and manufacturer of iron and steel products, and secondly, as a producer of pyromanganese. Our production of pyromanganese is restricted to the so-called standard grade. We produce our own requirements, as well as a tonnage for sale.

Mr. ADLERMAN. You are talking about pyromanganese.

Mr. SIMS. Standard pyromanganese.

As far as my company is concerned, we have had no direct project in connection with the beneficiation of manganese ores. We have, however, contributed the services of our people, materials and financial

assistance to the projects that have had some consideration given by various agencies of the Government, and independent companies.

Mr. ADLERMAN. Are there any particular research programs that you have contributed to in that respect?

Mr. SIMS. The American Iron and Steel Institute contributed to the Bureau of Mines project in connection with the recovery of manganese from slag. More recently we contributed slag to the pilot plant operations that Mangaslag initiated up at Pittston.

Mr. ADLERMAN. As far as the raw material end is concerned, Mr. Holderer has visited the Amapa mines of the Amazon, and we are well aware of the tremendous possibilities of the production of manganese. When do you expect that production will be started at the Amapa mines?

Mr. SIMS. We expect that manganese production will start in the fall of next year.

Mr. ADLERMAN. What grade will that run?

Mr. SIMS. The ore will run typically about 47 percent in manganese and contain about 5 percent in iron.

Mr. ADLERMAN. While we believe and advocate that we can defend the Western Hemisphere and that we will have to get our materials during the next war in the Western Hemisphere, still the experience has shown that in the last world war, the early years of the war, we lost a considerable amount of our ore carriers in the Caribbean. Without going into detail, the only potential enemy we have at the present time, the Soviet government, has almost five times as many submarines at this time as Germany had at the start of the last world war. We can expect, I think, quite a great deal of difficulty in getting any ore carriers through the Caribbean at least until it is controlled by our air and Navy forces. In that respect, we must, then, turn to what resources we can establish within the United States.

I am wondering whether or not your company has entertained any research plan for the domestic ores.

Mr. SIMS. Not directly of which I have any knowledge.

Mr. ADLERMAN. Do you think your company would advocate a program to beneficiate domestic manganese to a usable grade?

Mr. SIMS. I think the problem that exists is one that is dependent largely on a timetable. It is factual, of course, that manganese ore has been and is being stockpiled. It is factual, further, that new deposits, Amapa being one of them, will in all probability increase the availability of manganese ore. The determining factor in respect of the necessity, the urgency, of beneficiating domestic ores, I think is contingent on that timetable. That timetable, of course, we have no knowledge of.

Mr. ADLERMAN. The stockpiling figures are a secret, but I think it is common knowledge that manganese is probably our weakest item in the stockpile just because of the tremendous quantities that must be transported. In other words, we use over 2 million tons of manganese a year at the present time, or approximately that. In wartime, we would probably use more. That would require a tremendous number of ore carriers to bring ore up from the Caribbean or from any other nation in the world. We certainly will not be able to get it from India. As far as a time table goes, what you say is very true. If it is a short war, it will not be too material, but if the war is going to

go into any duration, it certainly will be very material. Do you agree with that?

Mr. SIMS. To some extent. We did secure manganese during the last war. We secured manganese even though one of the larger sources of supply did qualify its shipments very considerably. I am talking about Russian manganese ore. It is true, of course, that carriers were sunk. But imports of manganese did continue during the last emergency.

Mr. ADLERMAN. That was the latter part of the war, when we had the submarines pretty much under control, but we did not have it during the early part of the war, and we were faced with a situation where the difference in the size of the submarine fleets were 1 to 5, not the present rate. Are there any substitutes that you know of for manganese?

Mr. SIMS. No. Manganese is required in the production of steel. The quantity that is required, of course, is dependent on the grade of steel that is needed.

Mr. ADLERMAN. Can electrolytic or metallic manganese be used as an additive to the pig iron rather than using it in the blast furnace where part of the manganese is lost in the slag?

Mr. SIMS. I cannot answer that question intelligently. It would be a matter of metallurgical practice. I could not answer it.

Mr. ADLERMAN. What is the lowest grade of manganese that can be used commercially?

Mr. SIMS. Ferromanganese is produced as a result of a blending of ores. The lowest grade that can be used depends on what you have to mix it with.

Mr. ADLERMAN. I mean for a wartime emergency use, we may not be able to have the quality or the quantity of manganese that we need. Is there any way of getting it down below the stockpile grade of 40 percent? Can you use less than 40 percent?

Mr. SIMS. If there is a higher grade product to blend with it, an ore containing less than 40 percent manganese might be used in small quantities. Possibly I can best illustrate that by our experience during the last war. When the war broke out we had a considerable quantity of low grade South African ore on hand. We used it mainly as a blast furnace additive to increase the manganese content of our pig iron. It was desirable that that ore be used in the production of ferromanganese, and we mixed it with a high grade product, produced by Anaconda and were able by that means to reclaim the manganese in the form of ferromanganese that might have been otherwise used as a blast furnace addition.

Mr. ADLERMAN. Thank you very much.

Mr. SIMS. Thank you.

Mr. ADLERMAN. Dr. Reginald Dean?

STATEMENT OF REGINALD S. DEAN, CONSULTING ENGINEER, RIVERDALE, MD.

Mr. ADLERMAN. Dr. Dean, would you mind stating for the record your full name, title, and your qualifications?

Dr. DEAN. My name is Reginald S. Dean. I am currently consulting engineer in the general metallurgical field. My interest in manganese dates back many years. For some 17 years I was chief

metallurgist and later assistant director of the Bureau of Mines, and during that period the Bureau, as you know, gave a great deal of attention to the study of domestic manganese resources and we developed in the Bureau, among other things, the process—or a process—for the production of electrolytic manganese.

Since being engaged in private practice, I have done considerable work on the development of various processes relating to manganese, particularly the carbamate process, which is used by Manganese Chemicals. I believe you will have a witness from Manganese Chemicals.

Mr. ADLERMAN. I am sorry, Mr. Babbit was here yesterday and he was unable to stay over today. Dr. Dean, I wonder if you would describe your process to us.

CARBAMATE PROCESS

Dr. DEAN. Do you mean the carbamate process?

Mr. ADLERMAN. I believe it is called the Dean Carbamate Process?

Dr. DEAN. I can describe that process, yes. That process, of course, was the result of a great deal of study in the hydrometallurgical field for treating low-grade manganese ores, and we arrived at a solvent which is essentially an ammonium carbamate, which is obtained simply by adding carbon dioxide to strong solutions of ammonia. It was found that very large quantities of manganous oxide can be dissolved in such a solution. It is necessary, as in most of the processes except those using sulfur dioxide, to reduce the manganese in the ore to manganous oxide. The advantage of the carbamate solution is that very large quantities of manganese can be put into the solution; as much as 110 grams per liter, or something of that kind. The regeneration is on the face of it quite simple, because all you have to do is heat the solution and the carbamate reverts to the carbonate, and you get a very pure manganese carbonate. So that the product of the process is a very pure manganese carbonate.

That carbonate can, of course, be sintered to give you a high-grade nodule, not dissimilar to the Anaconda-type nodules. Of course, the plant at Riverton was put up by the Manganese Chemicals to give a large scale test to this process. It was put up under the sponsorship of GSA. Therefore, it was directed to the possibility of utilizing the Cuyuna ores to produce a manganese sinter which would be available for the production of ferromanganese. However, so far as my own position is concerned—with the Manganese Chemicals Co.—we were concerned with the utilization of the process to produce a premium product. It is, and has always been, my position as a student, if you will, of the domestic manganese situation, that the attempt which there seems to be in the thinking of most everybody's mind to convert the low-grade ores of the United States into Russian ores or South African ores, is not good thinking.

Ferromanganese is a product whose existence is based solely on the fact that the 48-percent and higher ores were available. To force the flow of manganese from our ores through a product which was never intended for low-grade ores, but which was clearly developed for high-grade ores, puts a terrific handicap on our low-grade ores. Most of our low-grade ores to get any reasonable concentration require hydrometallurgy.

Hydrometallurgy, in spite of our best efforts, tends to be expensive as compared to flotation. We have in this country plenty of manganese ores if you are willing to go down to grades which would make a bonanza in copper or zinc. But in copper or zinc you suit the process to get out copper or zinc, you do not try to suit the process to get out some artificial—artificial from the standpoint of chemistry, at least—intermediate. So I have never thought that our domestic ores should be forced through the channel of ferromanganese, but that we can go directly, or indirectly, to metallic manganese, to electrolytic manganese. I would say rather flatly that all of our ores are suitable for the production of electrolytic manganese. That does not mean that they are suitable to go right into the process which is being used today, either at Knoxville or at Marietta. I will point out some of the reasons why. But you can put our low-grade ores through a preliminary hydrometallurgy, and to that extent greatly simplify the electrolytic process so that you end up with a premium material.

To be sure, it is a premium material and, to be sure, it will take some adjustment of our manganese consuming industries—and not only the steel industry, which is, of course, the very large one, but the nonferrous industry as well, it would take some adjustment of those industries to use effectively electrolytic manganese.

But with that adjustment we have a means of utilizing a great quantity of our domestic manganese ores.

Mr. ADLERMAN. May I just break in for a moment there? Just what adjustment would have to be made? What is the nature of the adjustment?

Dr. DEAN. The nature of the adjustment, of course, is in the metallurgical technique of adding manganese to steel.

Mr. ADLERMAN. You mean adding pure manganese into the blast furnace?

Dr. DEAN. Not into the blast furnace, certainly not.

Mr. ADLERMAN. You cannot do it that way?

Dr. DEAN. No. The manganese that goes into the blast furnaces is not our main concern. We have plenty of ores which are satisfactory for adding a little manganese to blast furnaces. The problem is in ending up with the manganese additions in the finished steel—and the efficiency of the use of manganese in there depends upon the whole schedule of refining—and at what point you are going to add it and what else you have in there when you add it. All of that has been set up on ferromanganese.

Mr. REDWINE. Dr. Dean, is it more a psychological adjustment that is needed?

Mr. DEAN. No, there is nothing psychological about it other than, shall I say, an overall desire to do it. The present procedure for getting manganese into our steels is a traditional one. It works, it is tied in with the foreign sources, and to adjust our whole thinking to the availability not of an 80-percent rather impure ferro but to a highly pure metal takes an adjustment of thinking and it takes an adjustment of process. If you make electrolytic manganese from our domestic ores, you have an entirely different material. You have a metal, the effective use of which will require some considerable adjustments. In a great many cases you can use it. I did not mean to say you could not throw it into a blast furnace if you wanted to, but

that is exactly like choking a cat on butter. It is not the way to do it. Electrolytic manganese, of course, can also be used in the nonferrous industry to relieve the copper and zinc shortage. All of these things tie very closely together.

The point I wanted to make is about the electrolytic manganese development which was made—and which certainly was started—in the Bureau of Mines and carried out under the direction of Congress, the Boulder City station being built essentially for that purpose, the purpose of developing the use of Federal power and utilization of our raw materials. That process, which is certainly applicable to many domestic ores, and which was clearly shown to be applicable to the Three Kids ore, for example, was not used for the treatment of the Three Kids ore. What was used was a whole string of processes which I would just say flatly are nonsense. Anybody can jump on me who wants to. That is all right. That is their privilege. But we had an ore there which was ideally suited and ideally located with respect to power to make electrolytic manganese.

Instead of that we tried an SO_2 process that did not work, and now somebody has tried leaching out the silica with alkali, or something else, and concentrating it to an ore which still is not an ore.

Meanwhile, the electrolytic process has gone ahead in two directions, Knoxville and Marietta. But so far as I know, they are both using mostly foreign ore. Certainly Marietta is using 100-percent foreign ore. I do not know the momentary position of Knoxville, but certainly they are using mostly foreign ore. So the process that was developed by the Bureau essentially for the production of materials from our domestic ores has gone in the direction of being used for foreign ores and the developments which have taken place in it have been in the direction of using it effectively for foreign ores.

It is perfectly possible to tie that process in with a process like the carbamate process, if you will, where we come out with a pure carbonate, and make the process much more effective for our domestic ores. That is not the direction in which we have gone. Insofar as I know, nobody has contemplated going in that direction, because we get into this thing—and I am speaking freely and nobody has to agree with me, because I am in the fortunate position of not having any ax to grind—we get this situation which developed so fully in the War Production Board in the war and it has developed in GSA, of drawing a line around what we are going to do.

We are going to produce something of standard quality, or we are going to produce it in a standard way, or we are going to set up a plant to use the Cuyuna ores to produce something which is the equivalent of African ores. It is not that we are going to set up a plant to produce the most really useful material possible from the standpoint of our domestic economy. That is pretty much my position. There are a number of these hydrometallurgical processes that can be used.

The carbamate process undoubtedly has wide utilization. I am sorry that Mr. Babbit could not stay, because he could have told you, I think, of the rather successful operation of that plant for the treatment of Cuyuna ores. But if it is going to be economically successful from the standpoint of the company, he would have also told you that they have to sell manganese carbonate. They cannot sinter that stuff and sell it to the Government for stockpile at a price which is going to be profitable to the company.

The company has to make a premium product. They have to either sell the manganese carbonate or convert the manganese carbonate into something—battery oxide, electromanganese, or something—which can be sold at a premium price.

Mr. ADLERMAN. Your process, I think, is also applicable to the stockpile ores.

Dr. DEAN. If by my process you mean the carbamate process, yes. I have had a finger in so many processes. Yes; we made rather an extensive trial of it. I believe it can be used on all of the stockpiles. It can be used on Chamberlain. It can be used on most of them. Directly on Aroostook it is not too happy, but perhaps if Aroostook were concentrated by the 20 percent or something that Mr. Morris mentioned, we might go on from there.

Mr. ADLERMAN. Are you familiar with the terms of the Manganese Chemicals Corp. contract?

Dr. DEAN. Not too familiar. I am not too familiar with it; no. My relation to them was purely as a consultant and as the developer of the process.

Mr. ADLERMAN. Have you any idea how much was allocated by the Government for the plant?

Dr. DEAN. For the plant?

Mr. ADLERMAN. For the whole operation of the Manganese Chemicals Corp.

Dr. DEAN. I think it is something over $2 million.

Mr. ADLERMAN. Is that still in operation?

Dr. DEAN. The plant, so far as I know, is definitely in operation. They produced the necessary amount of material in a given time to satisfy the requirement of the GSA for the release of certain funds that were withheld, and now they are operating on their own. I mean to the extent that they are attempting to market the material which they make on a commercial basis. Mr. Babbit would have told you how successful they are at that at this particular moment. But I know that they are making battery oxide, and they are selling carbonate for commercial uses.

Mr. ADLERMAN. Is the Government stockpiling any electrolytic manganese?

Dr. DEAN. So far as I know, it is, but I do not believe the stockpile requirement for electrolytic manganese is very large. I am not competent, however, to speak on that subject. They were, at least, stockpiling some electrolytic manganese.

STOCKPILING FINISHED PRODUCTS

Mr. REDWINE. Dr. Dean, I would like to hear your views, and I am sure the committee would, as to the value of stockpiling an additive in its ultimate form, what your views on that are, and whether electrolytic manganese fits into that picture.

Dr. DEAN. That, of course, is something we have talked about a great many times. Of course when you stockpile a material that is further along the road to its ultimate use, you are stockpiling labor and power, and particularly in the case of an electrolytic metal like electrolytic manganese you are stockpiling power, which always becomes a short item in an emergency. To a lesser extent you are stockpiling labor. But it is certainly an effective means of stockpiling

materials rather than stockpiling them at some intermediate point, beyond which both power and labor have to be applied.

If you stockpile 48 percent manganese ore or manganese sinter, it still has to be put through an electric furnace. You still have a good many kilowatt-hours per ton to go into it when you convert it.

Mr. REDWINE. Doctor, we can make electrolytic manganese now. I realize we have to have more research in everything. Research never ends. But we can do it now and use our low grade ores?

Dr. DEAN. That is true, although we are not doing it.

Mr. REDWINE. But we can?

Dr. DEAN. Certainly we can.

Mr. REDWINE. And the Government could encourage that?

Dr. DEAN. We certainly put a great many tons of Three Kids ore, which is a typical low grade ore, through the electrolytic manganese pilot plant at Boulder City, in the Bureau of Mines. For that matter, Knoxville has run low grade ores. So there is no question that you can use low grade ores in the process as it now stands. But any chemical engineering process, as the grade of the ore goes down, the cost of handling the residue, goes up. Therefore, you must adjust your process to that. To a considerable extent we have done that in the carbamate process at Riverton.

The roasting procedure, for example, is applicable to a low grade ore, such as the Cuyuna, whereas the roasting procedure which was used in making electrolytic manganese from high grade ores would have run your roasting costs up too far, because you are heating too much material which is not manganese.

As I understand it, at the biggest plant, at Marietta, they have actually gone, instead of roasting, to making ferromanganese and then dissolving it up, which, of course, would be applicable only to a ferrograde ore. It is my current thinking that the ores, the low grade ores, should be put through a hydrometallurgical process to produce, shall we say, pure carbonate, which, if you have it in hand, greatly simplifies the electrolytic process. In fact, it changes it rather radically, so that you have an overall combination which can produce electrolytic manganese more effectively.

But, of course, that requires further study, because the development that has gone on in the electrolytic process has gone on in the direction of more effective use of foreign ores.

Mr. REDWINE. Dr. Dean, yesterday witnesses for the Bureau of Mines stated that we needed about 5 years, and about a year and a half—I think they got down to—of more study for these processes, and then we needed about 3½ years of plant building and all. In other words, about 5 years from now maybe we might be able to whip this problem.

Dr. DEAN. Of what?

Mr. REDWINE. Of becoming self-sufficient in manganese. What do you think of that?

Dr. DEAN. Well, I was with the Bureau 17 years, and that has been 10 years ago, so we have been whipping this process for some 30 years as it stands. I have a philosophy, again, which is that the way to whip it is to get into production on something which at least comes close to a competitive situation and then expand from there. I think it is difficult if you are talking about building a bunch of

plants which would require subsidy to operate, and would require $2.38 a unit for manganese, when we used to talk about 30 cents as if it was a lot for manganese. You can do it, yes. You can do anything. You can do it just the way we make U–235. But it costs a lot of money.

My own thinking would be rather to encourage, by whatever means of encouragement are available, the development of industries which can produce something which can currently come somewhere near competing or actually compete, and then try to expand from there rather than going holus-bolus into putting up I do not know how many million dollars worth of plants, but a great many million dollars worth of plants, to produce something which could be rendered worth 50 or 60 cents a unit by suitable trade arrangements with South Africa.

Mr. REDWINE. Dr. Dean, the staff of this committee—I do not want to argue with you about one point—we wonder if you might not be mistaken about electrolytic manganese being on the stockpile list. We have been unable to find it.

Dr. DEAN. All I am able to say is that at one time, and it may have been several years ago, they did have some electrolytic manganese in the stockpile. That is all I can say. I have not followed the stockpile requirements and, of course, would have no very good means of following them.

Mr. REDWINE. Dr. Dean, I have one more question, if you please. Suppose that today the electrolytic manganese went on the stockpile list, and the requirements would be double what the production of electrolytic manganese is today.

Dr. DEAN. That would not be much, 50 tons a day or something.

Mr. REDWINE. Say it was tripled.

Dr. DEAN. All right.

Mr. REDWINE. Would that be incentive enough for industry to go out and double its capacity in production?

Dr. DEAN. If the stockpile price were right, of course it would be.

Mr. REDWINE. What would be a right price?

Dr. DEAN. I certainly would not recommend that we continue to expand the electrolytic manganese industry with its face toward foreign ores. The present price of electrolytic manganese would be adequate, I think, to develop some interest if it were a stockpile item, and the sales problem were not there.

Mr. REDWINE. Dr. Dean, suppose they said that they wanted 500,000 tons from domestic ores. What would happen?

Dr. DEAN. Well, I do not know what would happen, but I would certainly recommend very strongly to the people that I am associated with that they put in a plant very quickly, using variations or what we may call improvements of the process for domestic ores. I would certainly recommend that both Cuyuna and Three Kids be put through the electrolytic process. I have always recommended that Three Kids be put through the electrolytic process.

ESTIMATED COST OF ELECTROLYTIC MANGANESE

Mr. ADLERMAN. What would be the cost of the electrolytic process?

Dr. DEAN. I have been called a liar so many times in my estimates of producing electrolytic manganese that one more time would not

make any difference. Of course prices are always going up and getting out of hand. But I have never seen why electrolytic manganese should cost more than 20 cents a pound.

Mr. REDWINE. How much?

Dr. DEAN. Twenty cents a pound.

Mr. ADLERMAN. What would you figure the electrical requirements would be?

Dr. DEAN. Four kilowatt hours per pound on the outside.

Mr. REDWINE. What is the present price of electrolytic manganese, Doctor?

Dr. DEAN. Around 30 cents a pound. You have people here that can tell you with far greater accuracy that I can. I am saying around 30 cents a pound. I believe in carload lots it gets down into that area of 30 to 33 cents a pound, or along in there.

Mr. REDWINE. Dr. Dean, suppose this thing we are talking about goes on the stockpile list in quantity at a good figure. How soon could a plant be built to go into major production of electrolytic manganese?

Dr. DEAN. I think right now in about 2 years. I think the delivery situation on electrical equipment, which would be your major thing, is in fair shape now. Of course there is another factor, and that is the allocation of power, and the allocation of power is, of course, today having a lot to do with the Government. If you could get Fort Randall power, for example, you might treat Chamberlain and Cuyuna. The power from Boulder is pretty well tied up. We had hoped very much, originally, that power from Boulder would go into electrolytic manganese. Today I do not know how much of an allocation you could get from Boulder power to treat Three Kids ore, although I understand some commercial interest is belatedly being taken in the production of electrolytic manganese from Boulder power.

Mr. REDWINE. If the Government wanted to go into the production and stockpile of electrolytic manganese, it could have those things.

Dr. DEAN. Yes. It is purely a matter of the will to do it on the part of the Government, industry, and the people.

Mr. REDWINE. All of those factors being considered, the matter of power and the present situation in respect to equipment deliveries and all, you think it could be done within 2 years?

Dr. DEAN. Yes, I think it could be, if it were gotten at. It could be done in 2 years. Good-size plants could be put up. The unit operations are well known, and while I would certainly suggest some improvements, they would not be such as to require any great campaign of research.

Mr. ADLERMAN. George, have you any questions?

Mr. HOLDERER. No.

Mr. ADLERMAN. I have just one more question, Doctor. I take it that you feel as far as the field of research we are going up the wrong avenue, that we should devote ourselves more to the proposition of getting an electrolytic manganese or a pure manganese rather than try to upgrade our manganese to a 40 percent grade?

Dr. DEAN. I have said that before, and I will say it again. I do not think you are giving the domestice ores a fair shake, or the possible producers from domestic ores, when you say to them, "You have to produce not something which has the superiority and which will always carry a premium, but you have to produce the equivalent of an ore that can be dug right out of the ground in Africa."

Mr. ADLERMAN. Coming back to some of these other processes, the processes which are well known, such as mangaslag, and so forth, are those susceptible of being converted into electrolytic manganese?

Dr. DEAN. The Nossen product is. He produces, as I understand it, a fairly pure grade of oxide, which could be reduced to pure Mno and then you could feed a cell on Mno. I have, naturally, a prejudice toward the production of carbonate. But mangaslag I do not know, honestly, too much about. To the extent that you are trying to recover manganese from slags, you have introduced another problem. There you have, shall we say, a substantially free raw material. You have a raw material which is a waste product. So I would not attempt to say whether going from a slag back to a ferro might not be a practical procedure. But to go from a low-grade ore to a high-grade ore, which is exactly what you do in any of these hydrometallurgical processes, and to go from a very low-grade ore to a low grade ore, which is what you do by flotation, you still only have manganese ore. You still have something that is not substantially better for making ferromanganese than an imported ore. Maybe it is a little higher, and you can mix some low grade ore with it. But, basically, you have only a manganese ore.

Mr. ADLERMAN. As far as you are concerned, you have only gone about half-way?

Dr. DEAN. Yes, and you have done an uncompetitive thing. I think you have a fair chance of getting to electrolytic manganese from domestic ore at a price which is competitive for getting to electrolytic manganese from foreign ore, whereas you cannot possibly compete with the foreign ore, because all they have to do with the foreign ore is dig it out of the ground, and the only thing you have in your favor is the steamship rate.

Mr. ADLERMAN. Thank you very much, Doctor. We certainly appreciate your testimony.

I would like to recall Mr. Morris for a minute.

STATEMENT OF JOEL MORRIS, SOUTHWESTERN ENGINEERING CO., LOS ANGELES, CALIF.—Resumed

Mr. ADLERMAN. On the basis of the work that you have done, would you be able to say whether you would recommend the building of a plant for the purpose of making electrolytic manganese?

Mr. MORRIS. I am not too familiar with all the technicalities in the production of electrolytic manganese, other than it is probably similar to the production of any other electrolytic metal. I think it seems a secondary product. In order to make electrolytic manganese you have to produce a refined feed for the electrolytic plant other than raw ore. In other words, you have to insert some process such as the Dean carbamate process, or Nossen's process, or some such other process to make a feed material.

OBSTACLES IN PRODUCTION OF ELECTROLYTIC MANGANESE

So, first we have to get this acceptable or workable process to make the feed material for the electrolytic step. Whether making electrolytic manganese from our low-grade ores is competitive with making electrolytic manganese from high-grade foreign ores might be true.

But still we have this intermediate step to go through to get the feed for the electrolytic plant which up to now has not been perfected. Whether there is an advantage over ferromanganese, to the steel industry, in having electrolytic manganese, I do not know. Unless there is some way to take a low-grade ore and make electrolytic manganese out of it, which we do not know about, I would say that electrolytic manganese is in the same class as making ferromanganese out of a high-grade manganese material.

Mr. ADLERMAN. You feel that you cannot take two steps at once?

Mr. MORRIS. I do not see how. I think it is the same as in making any complex chemical compound of an inorganic nature. You need a certain raw material. For example, if you are making a fertilizer, synthetic fertilizer, if you are going to need nitric acid in order to make fertilizer, you must first make ammonia to make the nitric acid from and you can't use the ammonia and skip over the making of the nitric acid. It is the same thing here. In other words, they need some kind of a refined feed for the production of electrolytic manganese. Whether that feed is in the form of rich foreign ores that can be leached or ferromanganese that is leached or perhaps a pregnant manganese solution from a low-grade ore. Dr. Dean is proposing that we make electrolytic manganese rather than ferromanganese but much of our research has been trying to produce a suitable material to make these products we cannot skip the intermediate step. Our low-grade ores, as such, are no more suitable for the production of electrolytic manganese than the production of ferromanganese.

Mr. ALDERMAN. While you are doing your research on one end you can also do your research on the electrolytic end, can you not?

Mr. MORRIS. Possibly so, if there is a definite advantage to the steel industry in using electrolytic manganese.

Mr. ADLERMAN. Is not time of the essence here, and should not we try to do whatever we can to speed up the process?

Mr. MORRIS. I am sure it is worth studying. But as I say, you can take manganese dioxide or manganese monoxide and make manganese sulfate, or, for that matter, a myriad of manganese compounds or metallic manganese out of it as you would. In other words, you still have to get the intermediate feed to make electrolytic manganese.

Mr. REDWINE. You have to do that to get metallic manganese anyway.

Mr. MORRIS. That is right.

Mr. REDWINE. You have to upgrade the ores to get metallic manganese?

Mr. MORRIS. That is my impression. What we are speaking of here so far is taking the low-grade ore and putting it in the form of a nodule ore. If you wanted to, you could stop off with a pregnant solution of some kind and then take that over into an electrolytic plant, I suppose, and extract the metallic manganese somewhat in the form that you do with zinc or some other metals. I mean electro winning metals out of pregnant solutions or whatever the technique is. But, nevertheless, the point is it is not the chemical part of these processes that is the difficulty. It is straightforward. It is getting the prototype equipment to perform under difficult operating conditions. It is the machinery that is the problem, not the chemistry.

Mr. REDWINE. Has your research gone far enough, then, so that in that way you are ready to build a plant? Would you recommend the building of a plant with the process you were talking about?

Mr. MORRIS. Yes. I think you would have to pick out an ore and a plant could be built in a reasonable length of time; yes.

Mr. REDWINE. What do you mean by a reasonable length of time?

Mr. MORRIS. Well, 2 years. Again, it depends on what you are talking about. What size plant and where it is going to be, and what is the feed material going to be. In the case of using this open-hearth slag, I do not think it is as long a program as 5 years. But, nevertheless, that does not solve all of our problems. We are talking about utilizing all of our natural resources, not only slag but the low-grade deposits. A plant could be built.

Mr. REDWINE. In other words, quit playing with toy plants, the technology is known?

Mr. MORRIS. We know the chemistry. The chemistry was developed many years ago. We must have prototype equipment; we must make machinery to do a job, and that is the problem. You can fiddle around all you want with toys, but when the cards are down you have to make the big machines work, and the only way you can do that is in prototype pilot plants, but they must be big enough so that you can translate the results directly into large-production units.

Mr. ADLERMAN. Thank you very much, Mr. Morris.

I would like to call one more witness and then adjourn.

Mr. Cromwell, of Electro Manganese Corp.

STATEMENT OF ROBERT H. CROMWELL, ELECTRO MANGANESE CORP., KNOXVILLE, TENN.

Mr. ADLERMAN. Would you state your name, your title, and your connection?

Mr. CROMWELL. My name is Robert H. Cromwell. I am a graduate of Columbia University School of Mines and I am vice president of Electro Manganese Corp. whose plants are in Knoxville, Tenn.

Mr. ADLERMAN. I understand, Mr. Cromwell, that you are one of the manufacturers of electrolytic manganese?

Mr. CROMWELL. Yes. Up to April 1 of this year we have produced a total of 71,600,000 pounds of electrolytic manganese.

LOW-GRADE ORES UNECONOMICAL FOR PRODUCING ELECTROLYTIC MANGANESE

Mr. ADLERMAN. We have just heard some testimony from Dr. Dean about the utilization of the rich foreign ores in the making of electrolytic manganese. Would the domestic low-grade ores be susceptible to that process?

Mr. CROMWELL. They would, but they would not be economical to use and would require a large capital investment.

Mr. ADLERMAN. Under present conditions they would not be economical?

Mr. CROMWELL. No, they would not. I would like to call your attention to the testimony that Mr. Wanamaker, our president, gave in 1948 before the subcommittee of mines and mining of the Committee on Public Lands, House of Representatives. These statements still

apply to domestic ores compared to foreign for electrolytic manganese production. I am referring to pages 390 to 395, which covers the domestic and foreign situation almost exactly as we find it today, and which gives you a detail of our plant operation.

Mr. ADLERMAN. Have you done any research at all on the subject of beneficiating the domestic manganese ores?

Mr. CROMWELL. We operated our plant for long periods on Chamberlain ore from North Dakota and also from Cartersville, Ga., Embreeville, Tenn., and Batesville, Ark.

Mr. ADLERMAN. You say you did run these tests on some of these domestic ores, including the North Dakota ores?

Mr. CROMWELL. Yes; and also on the manganese nodules produced from Butte ores by the Anaconda Copper Mining Co.

Mr. ADLERMAN. Was that done with any Government money or was that done with private money?

Mr. CROMWELL. That was done entirely with private money.

Mr. ALDERMAN. Could you give us the results of those experiments that you performed.

Mr. CROMWELL. I would like to read you the same statement here that would affect us today. For instance:

It has been suggested frequently in the past that increased production of electrolytic manganese through utilization of domestic low grade deposits would augment appreciably our supply of manganese products. We do not subscribe to this theory.

The following are the reasons:

Electrolytic manganese cannot be produced cheaply enough to compete with standard ferromanganese, and ton for ton of product the plant investment costs are preponderantly in favor of standard ferromanganese. There is one of the fundamental facts which should be clearly defined in any preparedness program. Electrolytic manganese plants are expensive and use large amounts of critical equipment and electric power.

I might explain that our experience has been that electrolytic manganese production requires large amounts of ammonia and sulphuric acid which are very much in demand in wartime.

In a period of an emergency, there would be neither time nor materials nor any appreciable increase of our domestic supply by electrolytic methods.

It is an expensive process. The United States produced last year (1954), I think, 700,000 net tons of standard ferromanganese, of which about 200,000 was produced by electric furnaces. A plant or plants to produce an equivalent amount of electrolytic manganese would run in the neighborhood of roughly six or seven hundred million dollars, if you could supply the proper ores to feed it. It would be impractical to use low grade domestic ores without beneficiation.

Mr. ADLERMAN. We seem to have a little divergence of opinion.

Mr. CROMWELL. We do, and we have; for years.

Mr. ADLERMAN. Aside from the electrolytic manganese work, what work has been done about bringing up or upgrading the domestic ores, work done by your company?

Mr. CROMWELL. We have done no work on upgrading these ores but we have tried to use them in the plant as available to us.

Mr. ADLERMAN. In other words, you are going to be wholly dependent on what you can get from the stockpile and what you can get from abroad in time of war?

Mr. CROMWELL. That is right.

Mr. ADLERMAN. Do you think that is a very satisfactory reliance?

Mr. CROMWELL. That is the fact at the present time.

Mr. ADLERMAN. Do you not think something ought to be done about that?

Mr. CROMWELL. We do, and we wish to do everything we can to encourage research in the upgrading of domestic ores.

Mr. ADLERMAN. In other words, you would advocate such a program?

Mr. CROMWELL. We would.

Mr. ADLERMAN. Well, thank you very much, Mr. Cromwell.

Mr. CROMWELL. You are welcome.

Mr. ADLERMAN. I suggest we adjourn for lunch now. Since a lot of you people are from out of town, I think perhaps if we got back no later than 1:30 we can try to hear more witnesses in the afternoon.

We will adjourn now until 1:30.

(Whereupon, at 12:15 p. m., the hearing was recessed, to reconvene at 1:30 p. m., the same day.)

AFTER RECESS

Mr. ADLERMAN. Mr. Knapp?

Mr. Knapp, will you identify yourself for the record, your title and connections and qualifications and so forth.

STATEMENT OF S. R. KNAPP, PRESIDENT, THE TAYLOR-KNAPP CO., PHILIPSBURG, MONT.

Mr. KNAPP. My name is S. R. Knapp, president of the Taylor-Knapp Co., with main headquarters of the company at Philipsburg, Mont. My personal headquarters are Mount Kisco, N. Y. We also have production and research installations at Tracy, Calif. We are producers of manganese ore and manganese products up to the point of use by industry. We have been producing manganese in the Philipsburg district since 1945.

About 4 years ago we took over the Ladd mine in California, which has been the subject of some discussion at hearings before this and other Government committees. We constructed a plant there and went into production of battery grade manganese. That operation has now been terminated. We have continued manganese operations in Philipsburg, battery grade manganese, up until about 1951 when our reserves of that type of ore diminished. We have since been producing manganese of a quality and grade adapted to metallurgical use. Our operations are therefore pointed directly at the metallurgical market.

I hope my following remarks will be considered pertinent to the subject of these hearings, in that our situation translates the general subjects of research and economic considerations into the problems and accomplishments of a particular mining industry concentrating on manganese.

Mr. ADLERMAN. Just proceed in your own way.

Mr. KNAPP. I believe our operations are quite typical of the domestic manganese producing industry. There are a few larger companies, some very much larger, but there are hundreds considerably smaller. But we do go through pretty much the full range of mining

ore, beneficiating the ore and treating it finally to a product which can be used by the iron and steel industry, including the ferro manganese producers.

We reflect in our operations in Philipsburg the results of research on the part of the Bureau of Mines, other industries and our own research and testing efforts.

We are faced with the same problems that confront every other domestic mine in the way of high costs, particularly labor costs, as compared to the costs involved in production overseas.

We have other economic factors to consider at all times in this present effort to produce metallurgical manganese for the Government stockpile. Under these present programs we now have 3 years left in which we must amortize the cost of any improvement or installation we make in our property. That includes not only the facilities we might install in our plants for further beneficiation or treatment but also exploration costs and mine development.

We are hopeful that we may be able to continue operations on a commercial basis after the expiration of these programs, but that I am afraid is a wishful thought.

Mr. ADLERMAN. Do you find that the depletion allowance of last year is helpful at all?

Mr. KNAPP. Yes, I would say that was a very worthwhile step for the benefit of domestic mining industry. It has been a benefit to us.

Mr. HOLDERER. You have DMEA exploration aid, have you?

Mr. KNAPP. Yes, we have.

Mr. HOLDERER. Have you completed that project?

Mr. KNAPP. No. That project will carry on for at least an additional 2 years from now.

I have prepared a statement from which I would like to read, in which I mention that matter in a little more detail. But it has been proceeding quite satisfactorily, I feel both from our standpoint as well as DMEA's.

Mr. ADLERMAN. Do you have a prepared statement?

Mr. KNAPP. I have wanted to raise a particular question. I mentioned how we are involved in questions of research, economics and finance and all that, but there is one particular problem in manganese production which is common to many other materials that becomes increasingly important as we go into these various phases of research, and plan out what we shall do in our operations. That is the question of specifications.

Senator Murray mentioned yesterday the phrase "a usable grade of manganese." That is a broad definition. We, however, in the mining business, are confronted with a rigid specification in some respects, but one that is wide open in other respects. I would like to point up the significance of this basic question of what is a usable grade by describing briefly some unique characteristics of ore from Philipsburg that have not yet been properly considered. I have prepared this brief statement, and, with your permission, would like to read portions of it.

Mr. ADLERMAN. You read any portions that you feel are pertinent. Or we can put the whole thing into the record.

Mr. KNAPP. Very good.

SPECIFICATIONS FOR MANGANESE ORE

The record of hearings before committees of the Senate and the House of Representatives over recent years contains many references and some pertinent discussion in regard to specification limits for domestic manganese ore to be stockpiled for metallurgical use. This record traces relaxations from the original specification of the Metals Reserve Co. prior to 1944, reflecting recognition that domestic deposits of manganese and beneficiation processes have been incapable of producing consistently, economically and in adequate volume a quality of product comparable to imported metallurgical manganese from India, South and West Africa, Cuba, Brazil, the Philippines, etc. A satisfactory specification for domestic production is therefore not a new question, and it should perhaps be considered and expected to be a perennial one.

It seems logical and proper that the Government should extend its activities and responsibilities to include the more technical aspects of specifications for strategic materials. There is little incentive beyond the altruistic for the consuming industry to spend time and effort on technical questions related to domestic manganese when over 90 percent of its needs have adequately, if not preferably, been met from foreign sources. Metallurgical techniques develop around the characteristics of materials found to be most economical and readily available. Domestic producers of manganese have little opportunity, and, in most cases, would not be qualified to sit down with the consumers and work out jointly the solutions to their respective production problems. On the other hand, a technical branch of the Government, such as the United States Bureau of Mines, should be well qualified to sort out the many factors involved and act as arbiter between the domestic producers and the consuming industry to best mutual and national advantage.

The published figures for deliveries through 1954 against the GSA carlot program, 2,275,617 long ton units against the 19 million units authorized in 1952, are a clear indication of the difficulties being faced by operators in this country in meeting the specifications applicable to that program. On the other hand, there has been considerable activity and reasonably good results against the companion GSA purchase programs covering the stockpiling of subgrade ore and concentrates requiring further beneficiation or other treatment to meet the requirements of industry.

The performance under these ore stockpiling programs reflects the large availability of cheaply mined surface or near-to-surface oxide ore in the southwest area served by the Wenden and Deming stockpiling depots, and an appreciable tonnage of carbonate and oxide ore that can be mined and upgraded economically in the Philipsburg and Butte areas of Montana, the latter excluding, of course, the fully integrated operations of Anaconda Copper Mining Co. in the production of manganese nodules and ferromanganese from its own properties.

Deliveries to date to the GSA depots in Philipsburg and Butte do not, however, reflect the potentialities of these districts, nor the thought, effort and investment being devoted to developing a major manganese industry in Philipsburg. With the aid and encourage-

ment of the present governmental programs during this period of development, and more general appreciation of the characteristics and capabilities of its products this industry may well be able to continue operations on a commercial basis after the expiration of these programs.

It should be noted that current exploration contracts with Defense Minerals Exploration Administration in the Philipsburg district exceed $750,000 of contract value, to which DMEA is contributing 75 percent for exploration of the potential reserves of manganese ore, and that these commitments comprise some 60 percent of country-wide DMEA projects applicable to manganese. This should be an indication of the appreciation on the part of DMEA, including USGS and USBM, of the potentialities of the Philipsburg district as an important source of domestic manganese and the confidence of the operators in being able to establish a long-term profitable industry. This remark is not to minimize the obvious importance, actual and relative, of the other manganese districts of the country participating in the Government's various programs, but is designed to point up an anomaly where so much has been committed for exploration, development and treatment processes in a district that has so far produced a relatively small tonnage of manganese.

There are a number of reasons for this situation. The upper levels of the mines at Philipsburg have produced a substantial tonnage of oxide ore which, after concentration to rigid specifications, has always found a ready market as battery-grade manganese, both for industry as well as for the national stockpile. Minerals in this oxide ore have the special and rare qualities required for dry-cell batteries, which is true of only a very few manganese ores in the world, and of that from only one other district in the United States. The bulk of this oxide ore from the Philipsburg district has been exploited for and delivered to the dry-battery market, but with serious depletion of reserves for future production.

Below the oxide zone in Philipsburg, which ranges to a depth of 300 to 600 feet, the manganese deposits at Philipsburg consist of the carbonates, chiefly rhodocrosite. Present exploration is aimed at production of this type of ore. It is comparable to the carbonate ore being mined in Butte by Anaconda, but reflects some important differences in mineral composition and geological occurence.

The frequent association of manganese with the base metals is parallel to the situation at Butte in respect to mining and economic considerations, but the areal aspect of limestone as the country rock distinguishes the Philipsburg district from standpoints of treatment processes, composition of the finished material, and the related economics.

Serious questions have accordingly arisen as to the adequacy of existing government and industrial specifications. The effect on production from the Philipsburg district would be marked if specifications and price differentials should take into account the unique and essentially desirable qualities of Philipburg manganese. There may well be a natural parallel between the rare characteristics of Philipsburg oxide manganese that are needed for dry-battery manufacture, and the equally unsusual characteristics of Philipsburg carbonate manganese that could take an important position in the metallurgical field.

The use of manganese ore in a ferrous metallurgical process, such as the blast furnace for iron production or the ferromanganese furnace, whether coke-fired or electric, involves generally the same technical considerations that apply to iron ore. The chemical reactions taking place within the furnace are exceedingly complex, necessitating careful control of the operation and the composition of the furnace charge, but the essential fact prevails that the amount of flux and resultant slag need be no greater than necessary to remove the gangue minerals and impurities.

The fluxing operation will have performed its function properly and most economically when the necessary quantity of slag produced is composed of approximately equal proportions of acidic and basic chemical compounds. Any excess of one type of compound over the other, going into the furnace, must be offset by an addition of the other type to maintain the chemical balance of the furnace charge and of the slag. Such necessary additions of fluxing compounds take up furnace capacity, consume fuel, and have the effect of diluting proportionately the grade of the ore being treated.

The bulk of iron ore being processed in this country contains an excess of the acidic gangue minerals, silica, and alumina. This necessitates the addition to the furnace charge of lime and magnesia as the basic offset to achieve chemical balance in the furnace. Limestone is generally used for this purpose, with 2 tons of the rock being needed for each ton of necessary lime addition. A typical 50-percent iron ore from the Lake Superior district, containing 8 percent silica, will require a 16-percent addition of limestone as a fluxing agent in the furnace charge, which has the effect of reducing the iron content of the combination in the furnace to 43 percent. Over 30 million tons of limestone are consumed annually for this purpose. On the other hand, certain iron ores in the southern Appalachian area and in France and Britain contain naturally the basic compounds of lime and magnesia in a combined percentage approaching and often exceeding the ore's content of silica-alumina. Little or no lime need therefore be added to the furnace charge when smelting these ores. So they are termed self-fluxing ores. They are processed economically in grades as low as 30–35 percent iron, and competitively with much higher grades of ore containing the more usual excess of silica.

Since these same factors apply to manganese ore, comprising a portion of the iron blast-furnace charge, or as the chief ingredient in the ferromanganese furnace, emphasis has always been great on minimum silica content. The bulk of manganese ore used in ferrous metallurgy contains 45–50 percent manganese, and 8–10 percent silica-alumina, with a negligible content of lime and magnesia. The use of this ore accordingly requires an addition of lime to the furnace charge, as in the case of the iron ore, to balance its excess silica-alumina content.

In the production of ferromanganese the necessary addition of lime generally exceeds, percentagewise, the silica-alumina content for other technical reasons. The economic effect of such necessary lime additions on furnace capacity, fuel requirement, and dilution of furnace feed, accordingly justify the attention to silica content reflected in present specifications, but, as in the case of iron ore, suggest careful attention and recognition to the benefits accruing from a natural content of lime and magnesia in the ore itself.

In contrast to the large reserves of self-fluxing iron ores in this country and in Europe there has been available to industry very little manganese ore of this type. An exception is just now being recognized in the case of Philipsburg manganese. Typical carbonate ore from this district, after upgrading and sintering to 40–45 percent manganese, will contain approximately equal percentages of lime-magnesia and silica-alumina to the order of 8–12 percent of each combination, and, therefore, may be considered a self-fluxing ore for metallurgical purposes.

Considering the purely mathematical effect of the necessary lime additions to offset excess silica-alumina content in other ores, this typical Philipsburg product would be equivalent to a 48–54-percent manganese ore containing 10 percent silica-alumina, which is superior to the preferred base specification set forth in the GSA nationwide (carlot) manganese regulation.

There are known to exist large reserves of this high-lime manganese ore in the Philipsburg district which have previously been considered submarginal, but would promptly become important additions to the country's manganese reserves if full recognition were given to the value of its lime-manganesia content as an offset not only to its own silica-alumina content but often to that of the other materials with which it would be blended in ferrous metallurgy.

Because of earlier difficulties in concentrating this high-lime Philipsburg manganese, the present GSA program for stockpiling carbonate ore at Philipsburg penalizes ore containing over 9 percent combined lime and magnesia. Accordingly, the tonnage and composition of deliveries to the Philipsburg depot reflect selection of ores mined to maintain the lime-magnesia content of the product within the penalty-free limit. This has correspondingly resulted in an increase of silica-alumina content in delivered material above what otherwise would have been its average.

Despite this artificial situation, the excess of silica-alumina over lime-magnesia in a 46–48 percent manganese product, obtainable by sintering the present stockpile of concentrates at Philipsburg, would not be more than 5 percent, and such a material should be comparable, technically and economically, to a natural manganese ore of this grade, and superior to much of the imported ore now being used. Subsequent research and testing on the part of USBM and industry have confirmed that the lime-magnesia content of crude ore does not affect flotation efficiency in producing a concentrate of sinterable grade. The existing penalties in the GSA program for Philipsburg carbonate ore would, accordingly, seem to have no purpose, and their retention could only continue to restrict production and extend the tonnage of nontypical ore in the Philipsburg stockpile. The removal of the present penalties, or, preferably, the placing of this phase of the GSA purchase program on the recoverability basis now applicable to the oxide programs at Butte, Wenden, and Deming, could not help but have beneficial effect both technically and economically on Philipsburg manganese-carbonate production, and in the ultimate use of the final product.

The availability of this material results from quite recent technical developments and installations. Following a period of research and exhaustive laboratory testing, the Philipsburg plant of the Taylor-

Knapp Co. has just now been equipped for continuous sintering of manganese ore concentrates.

Feed to this equipment will consist chiefly of concentrates from the high-lime carbonate ore previously mentioned, but further installations under consideration may provide suitable sinter feed from the full range of manganese ores occurring in the district. The current development of sintering technique at Philipsburg is attracting widespread interest since it represents the first known attempt to produce manganese sinter from carbonate ores on a continuous sintering machine. Production testing has been eminently successful, and substantial deliveries to the national stockpile under the GSA carlot program are in early prospect.

The specification now applicable to domestic manganese production for the GSA carlot program, or as a basis for recoveries and payments at the GSA ore purchase depots, makes no reference whatever to lime-magnesia content in the finished product. The reduction of manganese content from the wartime minimum of 48 percent to the present 40 percent was not accompanied by any mention or indication of what other minerals in the ore might make up the difference. Silica-alumina is still limited to 15 percent, with only a vague and ineffective provision in the carlot program specification permitting a higher maximum under certain unidentified circumstances. The base-metal impurities and phosphorus, known to be deleterious in steel metallurgy, are rigidly limited. High iron content is restricted by price penalties. Beyond these, only lime-magnesia and certain other harmless, if not beneficial oxides, could exist in a natural manganese ore. The inference is therefore unavoidable that the formulators of this specification allowed for the possibility of an important content of lime-magnesia, and may have hoped for it, but for reasons of their own avoided reference to it. Premiums are provided in both the Government and commercial specifications for high manganese content, and low amounts of the harmful or troublesome impurities mentioned. A similar premium, or preferably a direct credit against silica-alumina content, certainly seems justified for lime-magnesia content. Full recognition of the metallurgical principle involved, and a corresponding adjustment of the present specification, could have much more effect on domestic manganese production than many of the technical and economic factors presently under study and discussion.

Mr. ADLERMAN. Mr. Knapp, have you had any discussions with anybody in the Government Programs on the changing of the specifications to include this lime content?

Mr. KNAPP. Yes, we have, on various occasions.

Mr. ADLERMAN. I see. Has any discussion been had with the stockpile people on this?

Mr. KNAPP. Yes.

Mr. ADLERMAN. What was the result of those discussions?

Mr. KNAPP. The subject was first raised, I believe, with them about 2 years ago by correspondence and in conversations with the people in GSA responsible for the stockpiling programs.

Mr. ADLERMAN. Did you meet with any opposition there?

Mr. KNAPP. No, I would not say they were opposed to it. They have considered the matter and there has been some subsequent discussion, but I would say no action has been taken. I could not say what they propose or whether the development of this material that

I am speaking of, in their opinion, had progressed to the stage that would justify such action.

Mr. ADLERMAN. Has industry recognized the usability of this ore, low-grade, as long as it has the balance of lime and silica?

Mr. KNAPP. I believe it is beginning to, but, as I previously mentioned, we do not have too much contact with the people that are in the end probably going to use these materials.

Mr. ADLERMAN. You sell your material to the Government, do you?

Mr. KNAPP. Yes.

Mr. ADLERMAN. All of it?

Mr. KNAPP. We have sold small quantities, that is, samples and a few carlot shipments, to commercial interests.

Mr. ADLERMAN. Have you made any contacts with the steel industry at all?

Mr. KNAPP. Yes.

Mr. ADLERMAN. To persuade them that this might be a good, useful product, even at a lower manganese content, as long as you balance it off?

Mr. KNAPP. Yes, we have. On the technical side. However, it is quite apparent, both to them and to us, that we are unable to talk in terms of a supplier to a consuming industry

Mr. ADLERMAN. That is a price situation?

Mr. KNAPP. We and they know that they cannot afford to pay us the prices which we at present are getting under the Government programs.

Mr. ADLERMAN. If it were not for the price situation, do you think that they would accept the ore with the lime content that you mention?

Mr. KNAPP. I feel so.

Mr. ADLERMAN. Do you think that in any kind of emergency price may not be such a factor?

Mr. KNAPP. We feel confident.

Mr. ADLERMAN. Do they indicate that to you?

Mr. KNAPP. I would not say that the conversations have progressed to that point. There certainly have been no statements made to discourage us in our belief that it would be economically justified under the emergency conditions that you speak of.

Mr. ADLERMAN. If it were not for the price, you feel that you could sell that ore in competition with the foreign ores even though the manganese content might be slightly lower?

Mr. KNAPP. Yes indeed.

Mr. ADLERMAN. Are there any other ores outside the Philipsburg ore district that carry that same lime content?

Mr. KNAPP. I know of none that carry it to the extent that the Philipsburg ores do. I do know that other production in this country does contain an appreciable percentage of lime-magnesia which still is not being recognized as a benefit.

Mr. ADLERMAN. Do you know whether or not the Anaconda production is of a similar nature? Does it contain a lime content?

Mr. KNAPP. No, that is not true. My statement made a brief reference to that.

The Anaconda manganese veins occur in granite. As a natural result, their minerals are not closely associated with lime and magnesia. In Philipsburg they occur in limestone as the country rock,

and the product will, therefore, practically always contain this high percentage of lime and magnesia.

Mr. ADLERMAN. Can you give us some idea of the operating costs of your production?

Mr. KNAPP. We would have difficulty even setting down our costs on our sintering operation, which is the latest stage of our treatment process. It has been only in test production for a number of months. It might be some little time before we could do that.

Mr. ADLERMAN. Do you think that if you did not have the Government price, you could meet market competition?

Mr. KNAPP. No. At the present time it would be quite impossible.

Mr. ADLERMAN. You mean your costs would be too high?

Mr. KNAPP. Yes. We are mining, you see, from five, six, nine hundred feet underground, and that is quite a different story from shoveling it up off the ground, as we have heard discussed.

Mr. ADLERMAN. What is the grade of ore that you bring up?

Mr. KNAPP. Our average grade would probably be, under present economic conditions—which I think is an important point—14 to 18 percent manganese.

Mr. ADLERMAN. You grade that up to 40 percent?

Mr. KNAPP. Yes, about 42 percent. We first concentrate the ore to a grade ranging between 28 and 32 percent. That concentrate then is sintered, which performs two functions: it calcines the concentrate, driving off the carbon dioxide content from the carbonate minerals, and agglomerates the material into large chunks to make it suitable for ferro use.

Mr. ADLERMAN. Is your process one that can be used on all the Philipsburg ores?

Mr. KNAPP. Essentially, yes.

Mr. ADLERMAN. And can it be used on other ores?

Mr. KNAPP. Not necessarily. I believe you had testimony this morning pointing out how each type of ore appears to require a different approach. There are many things in common.

Mr. ADLERMAN. I mean on your process are there any other ores in the States that you know of where it can be used on the same process?

Mr. KNAPP. Oh, yes. In fact, our operation in California uses the same beneficiation process we use in Philipsburg, which, incidentally, has not yet been mentioned during these hearings. We and our good neighbors in Philipsburg are the only producers using it, and that is high-intensity magnetic separation. That process has certain distinct advantages over flotation. We find it particularly useful where our ores contain base metals—zinc and lead. The magnetic separators remove the manganese, it being slightly magnetic, leaving behind the silver, lead, zinc minerals which are subsequently treated separately.

Mr. ADLERMAN. Are there any other ores with similar characteristics to your ore or that your process could be used on? As an example, Appalachian?

Mr. KNAPP. Quite possibly. We have treated quite a number of samples of ore from a good part of the western part of the country, and find they are amenable to our process, but we have not attempted to assess the process economically in relation to these other ores.

Mr. ADLERMAN. Could you give us some idea what your production is right now, unless that is a commercial secret?

Mr. KNAPP. Not at all.

We are treating, on the average, 80 to 100 tons of ore a day. The tonnage of our product will be directly related to the grade of that ore. When we treat the higher grades we produce 30 to 40 tons a day of concentrates. When we treat the lower grades, which we have treated down as low as 8 percent, production is very much lowered.

Mr. ADLERMAN. Perhaps if you did it on a large-quantity scale you might have a lower cutoff point.

Mr. KNAPP. Quite probably. We cannot say that a 100-ton plant is the acme of efficiency, but it does represent a satisfactory level for an operation of this type.

Mr. ADLERMAN. You have a carbonate ore?

Mr. KNAPP. Carbonate ore.

Mr. ADLERMAN. I have no further questions. If you have anything further to add, I would like to hear it.

Mr. KNAPP. No, I do not believe so.

Mr. ADLERMAN. I would like for you to submit your statement in full, if you do not mind, and any other additional information that you think the committee might have the benefit of.

Mr. KNAPP. Very good.

Mr. ADLERMAN. Thank you very much, Mr. Knapp.

Mr. KNAPP. Thank you.

Mr. ADLERMAN. Mr. Earle Smith?

Mr. Smith, will you state your full name and your connections.

STATEMENT OF EARLE SMITH, CHIEF METALLURGIST, REPUBLIC STEEL CORP., CLEVELAND, OHIO

Mr. SMITH. I am Earle Smith, chief metallurgist of Republic Steel Corp., Cleveland, Ohio.

Mr. ADLERMAN. Mr. Smith, you have done quite a bit of work on manganese?

Mr. SMITH. No. I would correct that by saying that my job is as steel mill metallurgist, and the company I work for is not a producer of manganese either as a blast-furnace product or an electric-furnace product. My business has been to use the alloys produced by others.

Mr. ADLERMAN. Does Republic make any ferromanganese at all?

Mr. SMITH. We make no ferromanganese and have no electric-furnace production of alloys.

Mr. ADLERMAN. You are dependent on others?

Mr. SMITH. Dependent on others entirely for manganese.

Mr. ADLERMAN. Have you engaged in any research at all on the subject of beneficiation of domestic manganese? Have you devoted any study to it at all?

Mr. SMITH. Personally, no. The company has done some work on Maine manganese, and a rather small amount of it.

Mr. ADLERMAN. Mr. Smith, you may proceed.

Mr. SMITH. We have done very little work, none of it done directly by Republic Steel Corp., in the beneficiation of what you might call the lower grades of manganese ore. We have provided funds that have helped a man named Dougherty to do work on the Maine manganese. It is just in the middle stages, hardly worthy of a progress report, I am going to say, and no plan in sight for the moment to put that in action beyond just determining whether or not the process has some possibilities.

Mr. ADLERMAN. Where is this work being done by Mr. Dougherty?

Mr. SMITH. It is down at New Bern, N. C., was where he was doing it. In fact, I am not sure whether he is actually working at the moment. He had a small laboratory there and it was one of modifications of chemical processing of manganese, and offers some possibilities.

Mr. ADLERMAN. I take it that your concern is probably very much concerned about the possibility that we might be cut off from manganese during a wartime emergency.

Mr. SMITH. Very much so. I have been connected with this type of work in there now for a great many years. I was working as a furnace helper in the furnaces in the First World War, and I know something about the upset of a shop in there when manganese is cut off. I listened to the discussion here yesterday as to prices. They paid more for one pound of manganese in 1914 than they paid me for an hour of work in there. The figures that you quoted yesterday seemed to me far inside of an economic break-off limit, having lived through the 1914 shortage of manganese which was not even approached in the Second World War nor has been anything like that in the Korean situation.

I feel that the economic breakoff point is far, far above the figures that you put in as values from what I heard yesterday.

Mr. ADLERMAN. We had some discussion a little while ago about the possibility of using electrolytic manganese directly into the manufacture of alloys. Have you had any experience along that line?

POSSIBILITIES OF ELECTROLYTIC MANGANESE IN STEEL MILL

Mr. SMITH. I think we ran the tests under the supervision of the Bureau in our plant on electrolytic for the steel industry. We have presently been engaged in rather extensive tests of electrolytic manganese, and it seems to justify itself. I am finding it difficult to get some of our furnace people to agree with the justification, but personally I believe that, even at the present market prices, electrolytic manganese can be used in the steel industry and in making some of the relatively simple types of products. I would not want to limit its use to the expensive steels like some of the chrome, nickel, stainless, or the chrome manganese stainless where I do hope they provide for that particular steel. But even in the ordinary type of product like automobile stamping sheets and the ordinary electrical steels like you use in a small motor it is my personal opinion that electrolytic manganese is justified for that use. I am unable to see how you could amplify the production of electrolytic manganese to provide for a large portion of our use, but I do hope that the Government looks favorably upon the production of electrolytic manganese as a real useful product under present prices and under present conditions.

Mr. ADLERMAN. I suppose you are faced with the problem of overcoming the inertia of the blast people or the furnace people from changing over?

Mr. SMITH. No.

Mr. ADLERMAN. Into another method of use.

Mr. SMITH. No. At least the company that I work for—we were hard up long enough to have gotten over that pretty well. Our biggest problem with electrolytic manganese at the present time is the small-

sized piece that it comes to us and the ease with which it gets trapped in slag and ladle additions, and that is the largest problem. It is a physical problem. Even that way, we feel it will pass. You will get a little heavier product, and it has desirable things. I personally feel it is competitive right now.

Mr. ADLERMAN. You were not present when Dr. Dean testified here this morning?

Mr. SMITH. No.

Mr. ADLERMAN. His thesis was that he felt that the best avenue for progress in utilizing domestic manganese would be to go directly to an electrolytic manganese from our low-grade ores, and that the electrolytic manganese can then be made into our alloys.

In the little study that I have given the problem I would question that rather considerably because of the situation of power and chemicals and other things. But that is just a personal opinion on my part.

If they could get that electrolytic manganese at a competitive price to foreign manganese do you think that it would be feasible to utilize the electrolytic manganese in the manufacture of alloys on a large scale?

Mr. SMITH. We are using it just as electrolytic manganese. I see no reason for subsequent alloying except under peculiar conditions that I cannot foresee now.

Mr. ADLERMAN. Thank you very much, Mr. Smith. We certainly appreciate your testimony.

Mr. SMITH. Thank you.

Mr. ADLERMAN. Mr. Andrew Leith?

Will you state your name and the capacity in which you appear, please.

STATEMENT OF ANDREW LEITH, LAVINO & CO., PHILADELPHIA, PA.

Mr. LEITH. I am Andrew Leith of Lavino & Co., Philadelphia.

Mr. ADLERMAN. Mr. Leith, you are one of the large importers of manganese, are you not?

Mr. LEITH. Yes, sir.

Mr. ADLERMAN. And you are also a producer of ferromanganese?

Mr. LEITH. Yes, sir.

Mr. ADLERMAN. Are you engaged in the business in any way whatsoever of domestic manganese production?

Mr. LEITH. We have been interested in it, yes.

Mr. ADLERMAN. You are not engaged in it, though, as such?

Mr. LEITH. No, not as a company

Mr. ADLERMAN. Where do you get most of your manganese at the present time?

Mr. LEITH. Oh, it is fairly divided. I would say India was the largest single source. India and Africa.

Mr. ADLERMAN. I do not know whether you were present when we had some testimony at previous hearings and at the last session.

Mr. LEITH. No.

Mr. ADLERMAN. It has been pretty well established through the Defense Department that in the next war, a future war, the ability of the United States to get any manganese from India is very seriously questioned.

The record in the last World War shows that the ore carriers were pretty badly hurt and at least 80 percent of the ore carriers coming up the Caribbean in the early days of the war were sunk.

The vulnerability of long sealanes between India and the United States to both air and submarine attack is present, and I think the Defense Department has practically written off the ability to get manganese from India. I guess you will agree with that.

Mr. LEITH. That is a military problem. They are the ones to judge that.

Mr. ADLERMAN. You are in the business; you know the facts.

Mr. LEITH. Yes.

Mr. ADLERMAN. Do you disagree with those facts?

Mr. LEITH. No, not at all.

Mr. ADLERMAN. Then, concededly, we have to rely on whatever we may have in the stockpile or what we have in the way of domestic production. Is that right?

Mr. LEITH. Yes.

Mr. ADLERMAN. Have you given any thought, or has your company given any thought to research on the upgrading of the domestic ores?

Mr. LEITH. Yes, I believe we have; a great deal.

Mr. ADLERMAN. Can you tell us something about what you have done about it or what your attitude is toward it?

Mr. LEITH. As an individual company, we have not done too much research; we are not constituted for research. But, on the other hand, we have taken part actively in the study of ore processes available. I have served on the National Acadamy Panel since it was formed, and I believe we will do everything we can possibly do to support the development of methods for using domestic manganese.

Mr. ADLERMAN. Do you feel that it is essential, or do you advocate a program for beneficiation of domestic ores?

Mr. LEITH. Well, that is a problem with respect to which I do not have the information to give you a competent answer because it is a military problem. If you could tell me when the war is going to start and how long it is going to last I could give you an answer.

Mr. ADLERMAN. I do not know that I could agree with you that it is a military problem. Our problem is one of requirements during wartime for our industry.

Mr. LEITH. That is true.

Mr. ADLERMAN. Assuming that we cannot get it from abroad, the only other course would be from domestic sources. Is that not so?

Mr. LEITH. Or stockpile.

Mr. ADLERMAN. Or stockpile. The stockpile figures, of course, are secret. You may have some knowledge of them or not, but it is generally acknowledged that it is the weakest item in our stockpile.

Mr. LEITH. Not to me. I do not know those figures.

Mr. ADLERMAN. At any rate, in a long-term war we would be in a very bad position. I think that is generally conceded. Do you not think under those circumstances that something must be done about promoting the research, the know-how and how to beneficiate domestic ores?

Mr. LEITH. Very definitely.

Mr. ADLERMAN. We might even get it off on commercial basis.

Mr. LEITH. Very definitely. There must be half a dozen such projects under way right now.

Mr. ADLERMAN. Are you the supplier of any of these big steel companies?

Mr. LEITH. A supplier?

Mr. ADLERMAN. Yes.

Mr. LEITH. Yes, we sell as many as we can.

Mr. ADLERMAN. Who are your principal customers, if it is not a commercial secret?

Mr. LEITH. I would rather not say. I am not in the selling end of it, and I might be wrong.

Mr. ADLERMAN. I see.

You are probably the largest individual importer of manganese?

Mr. LEITH. I would not say that. I would say at least two of our competitors consume much more than we do.

Mr. ADLERMAN. You mean manufacturers?

Mr. LEITH. Consumers. Most of them import their own ore. We are rather small.

Mr. ADLERMAN. Are those steel companies that you are talking about?

Mr. LEITH. I am thinking primarily of Bethlehem and United States Steel.

Mr. ADLERMAN. I mean outside the steel companies, you are probably the largest of the manganese importers?

Mr. LEITH. Outside of them, we are relatively large, but I could not say whether we are the next largest.

Mr. ADLERMAN. Thank you very much.

Mr. LEITH. Thank you, gentlemen.

Mr. ADLERMAN. Mr. L. W. King?

Would you state your name and connections for the record, please.

STATEMENT OF LOWELL W. KING, SALEM, OHIO

Mr. KING. My name is Lowell W. King, and I have had a private research laboratory about 20 years, or 25 now, working problems that are a little different than what our manganese problem is here.

In 1922 I did some work for Mr. A. J. Artz, of Cleveland, Tenn., who had consolidated about a thousand acres near White Oak Mountain, and had shipped about 1,000 tons of ferromanganese to the Birmingham mills. And at the end of the war—the war was over when I came in as a kid—the price went down to where his operations were no longer profitable.

About 5 years ago when the so-called manganese war started I sent my son down to find out if this property was still intact and if it was available.

Mr. Artz was dead, but the property was intact, and I was able to lease it from his widow. We started in.

In 1922 we found there was some cobalt in that ore which at that time had no market to amount to anything in the United States, and was considered an undesirable contaminant, as it would be today, in manganese.

We started in with the idea that we attempt to get some help in the DMEA in our method of procedure and so forth, and we found that they had not been faced with that problem, and were more or less forced on our own to develop a way, if possible, to upgrade most of this ore.

Now, while there is no ferromanganese down there, we felt that that could be skimmed off, and did not amount to much anyway. Mr. Artz had taken out most of the ore. The ore that remains is a whole mountaintop extending about 2½ miles. It varies a great deal in its manganese content. It will run anywhere from 4 or 5 percent up to actual small deposits of battery manganese oxide. It was my thought that if any profitable use be made of this deposit, we would have to devise a method to work it as a whole and have just two grades of ore, the ore that is worked and the ore that you push over the mountain.

We got some very helpful advice from Dr. Dean, and I think he kept me from spending a lot of time on things that would not have been fruitful.

We could not make sulfur dioxide methods of leaching or ammonia-leaching work well. I think the reason for that is the cobalt. You know the Germans called it the gremlin metal, and they had something there.

Mr. ADLERMAN. What was that?

Mr. KING. Gremlin. Cobalt makes unusual and complex compounds and its metallurgy is tough. We could work seemingly and get pretty good results at times, but we could not repeat them always. So, because it is a complex former, I felt that theoretically we should reduce the ore at the start to the lower oxides and get it down as far as we could and then start with the univalent method of getting it out, and that, of course, ruled out ammonia and sulfur. It left, as I could see, only chlorine as a usable method of attack.

We started in with a hydrochloric acid leach, and found it behaved very well.

Our process, as we developed it, constitutes a reduction of the ore with about 8 or 10 percent of powdered coke, in a rotary furnace, running at a temperature of 1,200 or more Fahrenheit, and then, as you feed in the ore and coke, the pyrometer will simply jump, and the manganese at that temperature gives off oxygen. Of course, it is well known where the critical temperature is, and if you have something in that charge that will take up the oxygen when it is liberated, then you bring your manganese to an MnO, manganese oxide form. If you keep it away from the air it will stay in that form. It will reduce the cobalt, and we later found a little bit of nickel in our ore, two small metallic particles.

So our procedure is to simply introduce reduced ore into hydrochloric acid and it reacts practically immediately. You do not have a long duration leaching problem.

Also, in the furnace our temperatures get rid of some trace elements that we consider undesirable, and, so, it is useful for that purpose. The leach in the acid is carried on until the acid is used up.

We have not attempted a continuous process on it, but we use a batch process. Our leach consists of manganese chloride, cobalt chloride, nickel chloride and iron chloride. The iron content of our ore varies a great deal. The inert solids that remain are filtered off, and the first thing we do then is to bring our pH up to the proper point where, with the pumping in of air, just pumping air through the filtrate, we reduce our iron to the ferric form and then to the hydrox-

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ide which theoretically should come out nice and white. In actual practice we bring our slimes out also.

Dr. Ralston brought up the problem of separation of slimes, and in this process we have actually added clay to the extent of 20 percent and run it through and found that our ferric hydroxide would take it out very nicely.

Our next step is to filter this ferric hydroxide out. It filters with difficulty; so we have to do this on a continuous filter. We take all the iron out in this way. Then we make our filtrate more acid to the point where, on adding either H_2S or what we actually use, sodium hydrogen sulfide, we precipitate out our cobalt and nickel as sulfides. Our manganese does not come out.

You have a very big spread between the point which cobalt and nickel will come out as a sulfide and where manganese will. So we precipitate that out and some of the other sulfide precipitating material that may be there. There are certain other elements that come out. We filter this precipitate off, and then have to get this precipitate into solution again immediately as a chloride because it will otherwise oxidize in the air to a sulfate and, then you get a very difficult precipitate to deal with. But if you get it into a chloride form at once you can store it for days without working it and have no difficulty.

The separation of the cobalt and nickel is done on a pH basis, and, while it is not clear cut, it is near enough. The purity of the end product that you want in cobalt and nickel determines the number of times you put each into solution since it is very easy to put your carbonates into solution and reprecipitate fractionally again. We have found that three precipitations give a nice result.

Then we add a little bit of ferric chloride to remove the sulphur in our filtrate, and we get it out as a FeS precipitate. Sulfur is an undesirable contaminant, and we get it out by simply pouring in ferric chloride that we make from our ferric hydroxide by adding hydrochloric acid to it, this we put in and hydrolize the iron out. As a ferric hydroxide, but before it comes out as a hydroxide, any sulfur unites with the iron and goes down as a precipitate. We are able to get rid of the excess sulfur in this way.

After filtering it is a very simple thing to precipitate out your manganese as manganese carbonate at a proper pH. We wash the precipitate and it is a product of very good purity.

We can check the purity of our material as for years I worked on a spectrographic project and we are quite familiar with this work. It is quite good for detecting purity of material.

To cut it short, our process, requiring the material that we have, is based upon: (1) The purchase of sodium chloride, (2) finely divided coke—fly dust is the technical term for it—(3) limestone, and (4) fuel.

You may wonder where the hydrochloric acid comes in. We have found that we can manufacture this. The problem simply is: Can we do it at a price that allows us a profit. This was a little tough to work on, and yet it resolved itself very nicely because we found that a process for making sulfuric acid had been developed by Kershikov that we became interested in as a cheap process, of course. He had built an acid plant and had used it in manganese and cobalt recovery in the Balearic Islands and got his plant up and in operation about 6 to 8 months before the Second World War started. The Germans

came in and occupied the island, held it for a few months, and then when they pulled out they pulled his plant down.

He had the United States patent on sulfuric acid process. On his death his widow enlisted the services of Dr. Garachi, head of the chemistry department in the University of Genoa. He added some parts to the sulfuric acid plant, and has a very efficient plant and a low-cost plant. I was able to get a license under their later-granted United States patents which included the design and operating data of actual existing plant on a 25-ton sulfuric acid basis per day.

Now, the source of the sulfur, of the sulfuric acid in our case, calcium sulfate reacted with coke. So that our process in recapitulation is simply this: We take sulfur dioxide—you can burn sulfur or you can get it from breaking up gypsum and what-have-you any method of forming SO_2, using nitric acid as a catalyst, the process makes a little more nitric acid than it consumes. Then when we have our sulfuric acid we simply dump our sodium chloride and the hydro chloric acid is formed as you need it, you heat the H_2SO_4 and NaCl and bring out the last half of the acid and you have then sodium sulfate left. You react that with limestone and you get sodium carbonate solution which is the only chemical we use as a precipitant right straight through besides the sulfide that I mentioned.

You manufacture a little more sodium carbonate than you use in the process.

So we have our reagent solution—sodium carbonate—and we end up with calcium sulfate, a solid precipitate which is reacted with coke and broken up into calcium oxide, carbon dioxide and sulfur dioxide gases, which gases are process recycled to form sulfuric acid. The thing is efficient.

We have 4 plants manufacturing sulfuric acid in this process in Italy, and 2 in England. One has just been completed. So our process resolved itself into something that comes into the line of feasibility, and I think I know from our own experience that we can work out 5 percent ores profitably because our 5 percent ores contain a few tenths' percent of cobalt and some nickel. But I think the whole thing could make possible the utilization of simply immense amounts of low-grade manganese ores that I think run throughout the Appalachians from Maine—we know down through Pennsylvania, where Bethlehem has done its work—clear down to the southern part of Georgia and Alabama.

Mr. ADLERMAN. Dr. King, do you have a contract at the present time?

Mr. KING. I have. I built a pilot plant under DMPA.

Mr. ADLERMAN. How much was allocated?

Mr. KING. $30,000.

Mr. ADLERMAN. When was the date of that contract?

Mr. KING. That was the 1st of September.

Mr. ADLERMAN. This past year, 1954?

Mr. KING. Yes.

Mr. ADLERMAN. How long is that contract to run?

Mr. KING. Six months.

Mr. ADLERMAN. You have another month or two?

Mr. KING. They will extend it, I think.

Mr. ADLERMAN. Are you getting any further money from them?

Mr. KING. I do not think I need any.

Mr. ADLERMAN. You think the $30,000 will be sufficient?

Mr. KING. I have my pilot plant up. Of course, we built only a small one, 1000 pounds an hour. I think it is sufficient to run a breakdown and get the feasibility.

Mr. ADLERMAN. When do you think you will be able to run your tests?

Mr. KING. I ran a few through the last week or so on acid brought in with carboys. We have not received our delivery on tank truck acid until this week.

Mr. ADLERMAN. Maybe it would be a little unfair to ask you about the results.

Mr. KING. We can get the stuff out; that we know.

Mr. ADLERMAN. I see.

Mr. KING. We have a margin of profit, I think, that allows us—In other words, I think we are faced with this: If we take everything we can get from the production of our manganese carbonate and sell it for running our plant we will still be very happy.

Mr. ADLERMAN. Your first runs are promising?

Mr. KING. Oh, yes.

Mr. ADLERMAN. They meet expectation?

Mr. KING. They are good.

Mr. ADLERMAN. They met expectations?

Mr. KING. They are good, oh, yes.

Mr. ADLERMAN. Are you going to have any byproducts? Are you going to take out cobalt?

Mr. KING. Cobalt and nickel are byproducts, of course.

Mr. ADLERMAN. Yes.

Mr. KING. Then we are trying to filter out all our slimes before we hydrolize our iron because if we do we have a byproduct in our hydroxide that will bring a few cents a pound.

Mr. ADLERMAN. Is that a particular type of ore that is just located in your particular area?

Mr. KING. No. I think that method would be amenable to working any ore that you could put in solution.

Mr. ADLERMAN. Do you think that might be good for, say, the Cuyuna ores or, say, the Aroostook ores?

Mr. KING. I think so.

Mr. ADLERMAN. It is only being applied to this low-grade ore in Tennessee and the southern Appalachians?

Mr. KING. That is right. That is all I brought up.

Mr. ADLERMAN. You have not tested any of the other ores?

Mr. KING. I have run some through in little groups. There is some up in Nova Scotia that a man sent me that could be worked.

Mr. ADLERMAN. This committee would be very much interested in the results of your tests as they come along.

Mr. KING. We are getting them right now.

Mr. ADLERMAN. If you expect to make a report to the GSA in the near future——

Mr. KING. Send a copy?

Mr. ADLERMAN. Either that or ask GSA to send a copy to us.

Mr. KING. Yes.

Mr. ADLERMAN. Do you expect to make a report to GSA?

Mr. KING. Oh, yes. I think their man will be in every once in a while checking our process.

Mr. ADLERMAN. Will there be any further need for research on your process?

Mr. KING. I do not know whether you call it research or not, but somebody should check that the two plants in England actually operate as we have been told.

Mr. ADLERMAN. You mean the sulphuric acid?

Mr. KING. To make sulphuric acid.

Garachi is a high-class man, and I have no reason to doubt the word of a man of that type, or standing on the figures that he gives on his sulphuric acid. It really runs itself.

Mr. ADLERMAN. I mean outside the sulphuric acid plant.

Mr. KING. The other stuff is old.

Mr. ADLERMAN. The other processing?

Mr. KING. The other processing is old and not covered by patents.

Mr. ADLERMAN. You think you can bring that 5 percent ore up to a usable grade?

Mr. KING. Yes. If you want purity you know you can calsine it to manganese dioxide.

Mr. ADLERMAN. I do not know.

Mr. KING. Well, you can. And if you give manganese dioxide a little wash with very dilute nitric acid you can take any trace of sodium salts out and end up with a product that will compare very favorably with Baker's manganese dioxide that they sell for chemical purposes because the precipitation is sharp and the precipitation point definite, there is nothing tricky about it.

Immense strides have been made in the last 5 years on automatic control of chemical processes, and we have controls that just, well, you do not rely on the human element to say "Here, a certain pH." You set it there and it automatically keeps it. That makes the process feasible, I think, because, outside of stripping your ore—and that is simply a project of going up to the mountain—and you have two grades, ore that is usable and ore that you push off.

Mr. ADLERMAN. What do you think the production costs could be brought down to on this ore?

Mr. KING. As near as I can figure, and figuring liberally, I think if we can get 14 cents a pound manganese content for our carbonate we will make good because of the cobalt and nickel in the ore. I think the base with no cobalt or nickel might have to raise that a little bit to make any money, but I would be perfectly willing to take my profit from that price.

Mr. ADLERMAN. What would your cost be for the 40 percent ore?

Mr. KING. It really does not make too much difference, and the reason for it you can see. It simply amounts to digging it up, crushing it and putting it through our atmospheric furnaces where we find that a number of smaller furnaces are more efficient than a large size. So it would be a battery of furnaces, oil fired.

Mr. ALDERMAN. Could you meet the competitive price of a foreign importer?

Mr. KING. That is on prices paid here. I would not want to go out on a limb on meeting foreign competition. We might, with our cobalt, providing they keep on paying $2.60 a pound. While we do not have a lot of it, we do not need a lot.

Mr. ADLERMAN. But by reason of your cobalt you could make out pretty well?

Mr. KING. You do not want to work for nothing. You still want a profit. I think that a lot of this stuff is so near marginal. Now there were a great many producers of manganese in the first World War in the South Appalachian that got out quite a little bit of ore, just hand-picked methods. You got mines all over the place. Those men were forced out because they could not meet foreign competition which came in after the war. Manganese came down very low after the first war.

Mr. REDWINE. You said 14 cents a pound is what you could get it down to. On the basis of 22.4 pounds per unit you have a cost of $3.03, as I figured it?

Mr. KING. They sell that long ton, don't they? Of course, this is pure manganese carbonate. That is premium stuff anyway you figure it because you can convert it into electrolytic manganese, if you have the power available. Using material of that purity you do not have a lot of the problems that they are meeting today down in Knoxville.

Mr. REDWINE. Would that be competitive at the present price, say, of $2.30?

Mr. KING. I think it would be because of the quality of the material. It seems to me it would. Whether or not that price will continue I do not know. But I think some such floor would have to be set. I think the price of electro-manganese is the thing that is going to set the price of your pure carbonate.

Mr. REDWINE. Your whole cost structure, however, is built around the cost of sulphuric acid, is it not?

Mr. KING. The cost of sulphuric acid, well, we have to buy coke, and we figure that at $20 a ton. We hope to buy it better because we are 11 miles from a barge dock on the Tennessee River, and this finely divided coke is a drug on the market in the steel industry because they cannot use it without compacting it.

Mr. REDWINE. What is the availability of sulphuric acid?

Mr. KING. Here is the trouble: It is available, that is, it should be. But you cannot afford to ship the stuff. In other words, we think we can manufacture at about the price that it costs us to bring it in if somebody would give it to us at the point of origin.

Our problem for the last 2 years has been a problem of keeping our costs down; it has not been a problem of going out and buying hydrochloric acid. We think if these sulphuric acid plants bring that down to the point where you can afford to buy it because you cannot afford to transport it. Trucks are expensive, insurance is expensive.

Mr. REDWINE. Taking your figure there of 14 cents a pound, then at the present price of cobalt and nickel, approximately what ratio will the cobalt and nickel byproducts have at 14 cents a pound?

Mr. KING. We figure that they will run about 25 to 30 percent of the total income.

Mr. REDWINE. Dollarwise?

Mr. KING. Dollarwise will be cobalt and nickel.

Mr. REDWINE. About 25 percent?

Mr. KING. Yes.

Mr. REDWINE. That would be in addition to the 14 cents that you mention?

Mr. KING. Yes. The 14 cents is more than enough to produce our manganese carbonate.

Mr. REDWINE. That is all.

Mr. ADLERMAN. Thank you very much, Doctor.

Mr. KING. Thank you, gentlemen.

Mr. ADLERMAN. Mr. Matheny, will you be kind enough to state for the record your full name and your connections?

STATEMENT OF FRANK MATHENY, PRESIDENT, MANGASLAG CO., FORT WORTH, TEX.

Mr. MATHENY. My name is W. F. Matheny, and I am president of Mangaslag. I live in Fort Worth, Tex.

Mr. ADLERMAN. How long has the corporation been in existence?

Mr. MATHENY. About 3 years.

Mr. ADLERMAN. Did your corporation have a contract with GSA?

Mr. MATHENY. Yes, sir.

Mr. ADLERMAN. When did they enter into the contract with General Services Administration?

Mr. MATHENY. 1952. The contract was negotiated in the spring and summer, and signed December 30, 1952.

Mr. ADLERMAN. How much was allocated by the Government for this operation?

Mr. MATHENY. Originally, $1 million.

Mr. ADLERMAN. That was a slag process, wasn't it?

Mr. MATHENY. Yes, sir.

Mr. ADLERMAN. Could you describe the process that was being used or the object of the research that you engaged in?

Mr. MATHENY. Yes, sir, if it is agreeable, I would like to go back a little bit and give some of the background connected with it.

Mr. ADLERMAN. Go right ahead in your own language and in your own way.

Mr. MATHENY. In the first place, I am not a metallurgist, myself. So my technical testimony could be had better through, say, Dr. Royster.

Mr. ADLERMAN. We have heard from Dr. Royster.

Mr. MATHENY. This started in 1951, immediately following the Korean incident. Preliminary negotiations were in 1951, terminating in the spring of 1952. We were requested to sponsor this piece of research work. As I recall it, they had 3 or 4 processes by which they might recover manganese from either open hearth slag or low grade American ores.

GSA had sponsors for the chemical ones, but did not have for the metallurgical process. This is commonly referred to as the Royster process. The work was done by the Bureau of Mines. I believe that after Dr. Buel's contribution of the so-called overlap step they thought the process had quite a bit better commercial or economic possibilities.

However, our getting into it was very little connected with money. It was purely a contribution to find out how to make manganese from open hearth slag if you had to do it at any price.

Also, it was considered practically impossible by the steel companies, or at least that is the impression we got.

The reason was there was no equipment to handle the temperatures involved. So from the start we figured that maybe the mechanical or equipment part of it was just about as much a part of the research as the process itself.

Also, we were told frequently that if anybody knew how to handle these temperatures, and so forth, it would be Royster from the Bureau.

Through GSA we arranged for Royster to do the design work. However, we had other consultants from time to time.

The plant was located at Coxton, in Pennsylvania, partly because it was never expected as a pilot plant to make money. Coxton did have 8 or 10 railroads which crossed there which was good railroad transportation, so slag could be brought in from the Bethlehem area, from Chicago, etc. It is close to the town of Pittston.

The Lehigh Valley had elevated railroad tracks, overhead storage bins, a wonderful water system on the Susquehanna that they leased to us at a very nominal rental. It was an area of acute unemployment.

Incidentally they have the most good men up there.

It was also in the anthracite coal fields, and part of the work was to evaluate how much anthracite could be used in diluting coke. The project was estimated to cost $1,250,000. The Government was going to furnish a million dollars of it, and private capital $250,000 of it, but as I recall it at the time GSA didn't have any funds earmarked for research. So it was written as a production contract where we would sell them ferro manganese, if, as and when we made it. If we didn't make any money, we would take our marbles and go home, so to speak. They would cancel the loan.

In 1954 another $400,000 was raised, again 80 percent Government and 20 percent private capital. This made a total of $1,320,000 Government funds and $330,000 private capital.

Mr. REDWINE. That is still a marble deal?

Mr. MATHENY. Yes, sir.

Mr. REDWINE. You could go home with your marbles?

Mr. MATHENY. Yes, sir. Then after we spent that, we spent over $400,000 more of private money.

Mr. ADLERMAN. Who were the private backers?

Mr. MATHENY. Well, actually the money was Sid Richardson's.

Mr. ADLERMAN. Sid Richardson?

Mr. MATHENY. Yes, sir.

We got over $750,000 in it, more than three times what we had anticipated, and we figured it was more than we could carry.

Mr. ADLERMAN. How far had you gone? Had you erected the pilot plant?

Mr. MATHENY. Yes, sir.

Mr. ADLERMAN. Is that complete?

Mr. MATHENY. I would say substantially, as pilot plants go. I have never been in direct research myself, but I have rubbed shoulders with research men. You never complete a pilot plant. You try this and tear it out and you try that and tear it out until you find something that works. Whoever picks it up and continues to operate it, I would imagine there would be many many changes yet to make.

Mr. HOLDERER. How long was it in operation?

Mr. MATHENY. Intermittently for the last 6 months of last year.

Mr. ADLERMAN. Six months?

Mr. MATHENY. Intermittently. We would make a run, say, of 10 days or 2 weeks, and shut down for repairs and changes.

Mr. HOLDERER. When was it shut down?

Mr. MATHENY. The last time it was shut down, was around December 20.

Mr. ADLERMAN. Does the corporation still control the plant or has it reverted to GSA?

Mr. MATHENY. It has reverted to GSA.

Mr. ADLERMAN. The corporation is out of the plant now?

Mr. MATHENY. Yes, sir.

Mr. ADLERMAN. Completely severed from the plant?

Mr. MATHENY. Yes, sir.

Mr. ADLERMAN. How many actual runs have been made in the plant during this intermittent operation?

Mr. MATHENY. I believe we have reports serially numbered through 7, of which the first 2 were of very short duration, principally just to test the equipment.

Mr. ADLERMAN. What were the results that were obtained?

Mr. MATHENY. They were very erratic. Some of them, to me, were startling. There were consistent runs of periods of time, let's say, of 24 or 36 hours, when the hot-blast temperature was well over 2,000 degrees, and maybe a thousand degrees hotter than an ordinary furnace, and the manganese in our own slag, our own waste, has been under 1 percent, and maybe averaged 1½ percent for a period of 36 hours.

And, again, I am not a metallurgist, but I understand 8 or 10 percent would have been considered commercial operations.

Mr. ADLERMAN. What recovery were you able to make of manganese?

Mr. MATHENY. As such, none. Based on the manganese content of our own slag, and the fume, manganese fume, that was caught in the electric precipitators and thickened in a Dorr thickener, and which could have been returned to the furnace with that part of the process, I understand, being fairly well known, it was operating at an indicated recovery of 90 percent based on the open-hearth slag material.

Mr. ADLERMAN. You say you indicated a recovery. How much actually was recovered?

Mr. MATHENY. None.

Mr. ADLERMAN. Why do you say "indicated" recovery?

Mr. MATHENY. That is a measure of the waste that we lost through the slag. You see, the fume content which might have been as high as 30 percent of the manganese in the raw material at those temperatures, went out with the fume, and that was recovered and measured but was not placed back into the furnace simply because we didn't have the equipment on the ground to do it.

Mr. ADLERMAN. If you had the proper equipment, you would have recovered the fumes, is that corect?

Mr. MATHENY. As I understand, that was something that was very easily salvaged. They know how to do that.

Mr. ADLERMAN. Why was the plant discontinued?

Mr. MATHENY. We ran out of money.

Mr. ADLERMAN. You ran out of the private money?

Mr. MATHENY. Yes, sir.

Mr. ADLERMAN. And you exhausted your Government money?

Mr. MATHENY. Yes, sir; and the sponsors did not wish to borrow more Government money.

Mr. ADLERMAN. Had you had any consultations with GSA about continuing the operation of the plant?

Mr. MATHENY. Well, they haven't asked us much.

Mr. ADLERMAN. Do you know whether there are any plans to continue the operation?

Mr. MATHENY. No, sir; I wouldn't know.

Mr. HOLDERER. Is it your opinion that the whole idea shows promise enough to make it worthwhile pursuing further?

Mr. MATHENY. My personal opinion is it should be finished by all means.

Mr. REDWINE. On what do you base that opinion, sir?

Mr. MATHENY. Well, getting back to the basic philosophy that this metallurgical process—and I might be right or I might be wrong there—it was our understanding that that was the only process that offered quick, big, tonnages of ferromanganese, again, at any price.

Any time you get the waste from it down to 1½ percent, I think in metallurgy that would be called phenomenal.

Mr. REDWINE. The basic philosophy of this contract was, though, to find out, with no regard for price, whether you can get some manganese production? That was the basic philosophy of this contract?

Mr. MATHENY. I think that was the basic philosophy, both from our side and from GSA's side. I am sure Mr. Jesse Larson put it just that way.

Mr. ADLERMAN. Have there been any steel companies interested in this particular project?

Mr. MATHENY. I don't know, sir.

Mr. ADLERMAN. Have they put in any money?

Mr. MATHENY. Not with us. I understand that they did do some work before, of which I am not very familiar.

Mr. ADLERMAN. But did they participate in this plan in any way?

Mr. MATHENY. No, sir.

Mr. ADLERMAN. Did they send any of their men over or investigate its possibilities?

Mr. MATHENY. They were quite interested and tried to keep up with it. I believe Mr. Hoffman, from Bethlehem Steel, was up there several times, and offered suggestions and advice.

Mr. ADLERMAN. Any of the other steel companies besides Bethlehem Steel?

Mr. MATHENY. Not that I know of.

Mr. ADLERMAN. Did Republic Steel take any interest?

Mr. MATHENY. They were quite interested and quite cooperative in furnishing slag for experimental work, and offered advice from time to time. But I don't believe that there was any technical man from the company there during the period.

Mr. ADLERMAN. Were there any other private investors?

Mr. MATHENY. Not that I know of.

Mr. HOLDERER. There were certain other byproducts which they hoped to make profitable, like phosphates and so on. Was any information gained along that line?

Mr. MATHENY. No, sir. The two little converters, the first of which was to receive the spiegeleisen or mixed metal and make the synthetic ore, and then the second converter to blow the impure iron and make scrap, were in place, but we never used them for the simple reason we never did make enough spiegeleisen.

We never did get the furnace to run continuously long enough to make the operation of the other worth while.

Mr. ADLERMAN. The thing that interests me particularly is the fact that about $2 million had been spent and still the private money that was invested didn't think it was worth while to continue it.

Still you say it holds promise?

Mr. MATHENY. That is my personal opinion; yes, sir. But I wasn't furnishing the money.

Mr. ADLERMAN. You still think it is something that holds a great deal of promise?

Mr. MATHENY. I think so.

Mr. ADLERMAN. How much more money do you think would be required to go through to have a real comprehensive test made of the process?

Mr. MATHENY. I don't know.

Mr. ADLERMAN. What would you estimate? I do not want to hold you down to a dollar-and-cent sign, but just give me an estimate.

Mr. MATHENY. Originally, I thought the million and a quarter would be enough.

Mr. ADLERMAN. You have your plant built and the process tried out.

Mr. MATHENY. With the plant substantially in place——

Mr. HOLDERER. How much of the total did that take?

Mr. MATHENY. Roughly a million and a quarter or a million three.

Mr. HOLDERER. Your capital expenses were out of the way pretty much then?

Mr. MATHENY. Pretty much. It is according to how long you have to do experimental work and how many redesigns and changes you have to make.

It could be anywhere from another million to 5 million dollars. In either case, to me it is little compared to what you are trying to gain.

Mr. ADLERMAN. I suppose it is too early even to discuss costs or costs of operations?

Mr. MATHENY. Roughly, running at full blast, it costs 4 or 5 thousand dollars a day to run it. That can be reduced by whatever materials you ultimately make, how much, and what you get for them.

Mr. ADLERMAN. Do you know whether any of the steel companies are interested in taking over this plant and operating it?

Mr. MATHENY. I don't know, sir. GSA might have contacted them. We dealt with GSA strictly. Our contract with them was that when we didn't make any money they would cancel the debt and we would give them the assets, and that is what we did.

Mr. ADLERMAN. You just walked out with a $750,000 hole in your pocket?

Mr. MATHENY. That is right. In fact, it was more than that.

Mr. ADLERMAN. Have you anything else that you could tell us about the process or the possibilities?

Mr. MATHENY. No, sir. I would think that that part of the testimony should come from the technical men that are better prepared to give good information. It is not that I object to expressing personal opinion, but for the record, you want to get the best technical information.

Mr. ADLERMAN. We heard Dr. Royster's testimony yesterday, but I would like to get your opinion about whether or not you feel that even

though you dropped $750,000 it would be worthwhile going ahead with it.

Mr. MATHENY. There is no question in my mind.

Mr. ADLERMAN. No question?

Mr. MATHENY. No, sir. If that were an oil company on a piece of refining equipment, they wouldn't have even been dismayed.

Mr. ADLERMAN. Are there any other questions?

Mr. REDWINE. Of course, I realize you haven't much to go on with your intermittent and short runs on it, but were your people able to project any cost figure at all as to what this material might cost?

Mr. MATHENY. That has been done on the assumption that you could get theoretically almost perfect recoveries and, theoretically, that plant, even at its adverse freight location, could make money.

Mr. REDWINE. At what price?

Mr. MATHENY. $200 a ton. That was the contract price.

Mr. REDWINE. The contract price with the GSA?

Mr. MATHENY. Correct. Theoretically, that plant, even with its location and with the double freight, shipping the material and shipping the products back could, theoretically, make money. But you know you are not going to get perfect recovery.

Mr. DDLERMAN. You will also have a chance to look over your tes-

Mr. MATHENY. It was rated at 100 tons of spiegeleisen a day, but with the wind equipment, and so forth, it could go to 150.

Mr. HOLDERER. It was a good-sized pilot plant but not a commercial plant.

Mr. MATHENY. Well, I would say it was semicommercial.

Mr. HOLDERER. A prototype plant.

Mr. MATHENY. Yes, sir. We expected, if it turned out as well as we hoped, to build some big plants in the vicinity of each concentration of blast furnaces, around Pittsburgh, for example, and Chicago.

Mr. ADLERMAN. Thank you very much. If there is anything else you would like to add, feel perfectly free to do so.

Mr. MATHENY. I understand that we do have a chance to do that.

Mr. ALDERMAN. You will also have a chance to look over your testimony. We will send it to you. If you want to add anything to it, please feel free to do so.

Mr. MATHENY. Thank you, sir.

Mr. ADLERMAN. Mr. Broadbent and Mr. Rouhana, please.

STATEMENTS OF SAM R. BROADBENT, CHIEF, COMMERCE AND FINANCE DIVISION; EDMOND J. ROUHANA, COMMERCE AND FINANCE DIVISION; AND SAMUEL M. DODD, ASSISTANT CHIEF, RESOURCES AND CIVIL WORKS DIVISION, BUREAU OF THE BUDGET

Mr. ADLERMAN. Mr. Broadbent, would you and the other gentlemen please identify yourselves for the record, giving your full names, titles, and your positions?

Mr. BROADBENT. I am Sam R. Broadbent, Chief, Commerce and Finance Division, Bureau of the Budget.

Mr. ROUHANA. My name is Edmond J. Rouhana. I am a budget examiner in the Commerce and Finance Division, the Bureau of the Budget.

Mr. DODD. I am Samuel M. Dodd, Assistant Chief, Resources and Civil Works Division, Bureau of the Budget.

Mr. ADLERMAN. Among the three of you, whom do you want to designate to answer the questions?

Mr. ROUHANA. Let me put it this way, Mr. Adlerman: In the Commerce and Finance Division we handle the budget for the GSA, including the stockpiling program, and also the Defense Production Act funds. The Resources and Civil Works Division, which Mr. Dodd represents reviews budgets for the Department of the Interior, including the Bureau of Mines. In order to expedite the answers to the questions that you may have, we would like to suggest that Mr. Dodd start out with the Bureau of Mines, because their programs are primarily related to the research area that you are discussing here.

I will be glad to answer after Mr. Dodd gets through about our functions with respect to the borrowing authority.

Mr. ADLERMAN. Suppose I address my questions and whoever feels he should answer, proceed to answer the question.

What is the function the Bureau of the Budget performed in approving the research program, particularly in the area of these mineral programs?

Mr. DODD. The steps in the preparation of a budget are somewhat complicated. For example, right now the bureaus and agencies are laying plans for their budget estimates for 1957. The function of the Bureau of the Budget is one of reviewing the estimates as they come into us from the departments and agencies.

One of the first considerations that we have to take into account is the fiscal policy prevailing in any given year.

Taken into account in that policy are the requirements of certain fixed costs that have to be met—we call them uncontrollable items—and then seeing what the overall fiscal picture is, both as to receipts and expenditures.

In our preliminary approach, we review the activities of the respective agencies and somewhere around the 1st of July a departmental ceiling is set for the cabinet official or agency head to plan his budget expenditures or his budget requests for the ensuing fiscal year. Dollar amounts are not fixed as a rule for specific bureaus or programs, so that the cabinet official has complete flexibility in choosing the priorities in their order of importance and thus present, as best he can, a well-rounded picture of all of the requirements of all of the constituent units of the department.

When those estimates are submitted, the department head is not restricted to the ceiling that is set for his agency. He has a right to request the ceiling amount; he can come under the ceiling, which they hardly ever do, or over the ceiling, which they generally do.

We review the estimates with the same care, whether they be overceiling or underceiling, and attempt to develop in our consideration of those estimates the essential items urgently needed, and in doing that we hold hearings with departmental officials, with the bureau officials—in the case of the Bureau of Mines with the top officials of the bureau—some of whom appeared here yesterday.

Upon the conclusion of those hearings, the program of the department is presented to the director for his consideration, review, and clearance with the President.

I might say that in our budgetary processes, the Bureau of the Budget is not confined to what we term the estimate season, running from about mid-September until about the time the budget is transmitted to Congress in January.

The staff of the Bureau are assigned the responsibility for constituent units of a department or agency, and are in almost day-to-day contact with those agencies, either visiting them in their offices in Washington, or making field trips to observe and investigate their operations in the field.

That is with the idea of being as objective as possible in knowing, understanding, and giving adequate support to the programs as they are developed.

Mr. ADLERMAN. As I understand it, then, what happens is something along this line: The Department of the Interior will be told that for the next year they can use X millions of dollars for their budget.

Mr. DODD. Correct. Excuse me, that is for planning purposes.

Mr. ADLERMAN. That is right. It is up to them to allocate it within their own department as to how much can be spent for each separate agency in the Department.

Mr. DODD. That is correct.

Mr. ADLERMAN. At any rate, they are met with certain fixed expenses that they must pay, and when it comes to a question of research, which is not a fixed expense, I suppose that is the tail end of the stick.

Mr. DODD. No, I wouldn't say so, sir.

Mr. ADLERMAN. Let us put it this way: How much were they allocated last year for research?

Mr. DODD. How much did they allocate for research?

Mr. ADLERMAN. Yes.

Mr. DODD. Where do you want to draw the line on this? Do you want to draw it on the question of manganese? I have figures with respect to manganese, but I cannot give you the whole picture.

Mr. ADLERMAN. Just manganese would be fine.

Mr. DODD. On manganese, for 1956, the departmental allocation, apparently, was $786,565. That is manganese alone.

Mr. ADLERMAN. $700,000?

Mr. DODD. $786,565.

Mr. ADLERMAN. They asked for practically the same amount, didn't they?

Mr. DODD. That is right.

Mr. ADLERMAN. And the year before?

Mr. DODD. The year before they requested $869,415. The amount that was included in the budget was $797,415. There is a difference there of $72,000, and that was taken off by the Department. They had a total allowance for the Bureau of Mines, and that $72,000 was taken off for development of reserves additional within the Artillery Peak area of possible manganese-bearing ores on the theory, I assume, that they had a pretty good picture of what was there for a number of years, and could drop that out without too much difficulty.

Mr. ADLERMAN. That $72,000, then, would be allocated to someplace else in the Bureau of Mines, is that right?

Mr. DODD. No, that was a reduction in their total allowance for 1956.

Mr. ADLERMAN. Was that allowance reduced by you or by the Bureau of Mines?

Mr. DODD. That was within the discretion of the Bureau of Mines. In fairness to them, it may be partially charged to the Bureau of the Budget, because of our fiscal situation. We had to reduce, but we left that in the discretion of the Department as to where they took the reduction.

Mr. ADLERMAN. You have to come within a certain figure to balance the budget or try to balance the budget.

Mr. DODD. In meeting the administration's objectives.

Mr. ADLERMAN. So you have to hold the agencies down.

Mr. DODD. That is right. I might say in that connection I have the figures for 3 other years here, and to show you how these estimates have been handled I will recite them.

In 1952, the total request of the Bureau of Mines for manganese research of all types, was $1,262,000, of which $58,000 was overceiling. The budget estimate was $1,204,610. That was the exact amount of their underceiling request. The $58,000 overceiling had to do with the utilization of certain manganese compounds, manganese sulfate, chloride, and so forth, derived from the low-grade deposits.

Mr. ADLERMAN. Is that the highest amount they have been allocated in the last number of years?

Mr. DODD. I think so, sir. In that $1,262,000, if I recall the figure correctly, there was about $600,000 for the erection of a pilot plant to do some special work in connection with manganese, because the next year it dropped back about $626,000.

Mr. ADLERMAN. When you look over those figures, do you have the advice of any technicians on the budget?

Mr. DODD. Within the Budget Bureau staff itself, we have none of what we term the scientific personnel, peculiarly versed in Bureau of Mine activities. However, as I said a few moments ago, we are in constant touch with the people in the Bureau. We also keep current through examination of trade magazines, research reports, and then in connection with the processing of special requests of some sort of an urgent need tied to the defense or other activities we do get the advice of the Office of Defense Mobilization and the Defense Department.

Mr. ADLERMAN. You have heard some of the testimony, I presume, in the last couple of days?

Mr. DODD. Yes, sir.

Mr. ADLERMAN. And you heard, for example, Dr. Nossen had to cut out his research because they failed to get any more money.

You just heard this gentleman testify that after they had put in almost $2 million into a plant, they had to cut it out, even though they had very short, intermittent runs of the operation, just to the point where they should be given more money after spending so much money. They were cut off.

I do not know whether you realize the importance of the past, but I think you may realize now that the situation as far as manganese goes is probably one of the most critical in the entire Nation.

Certainly some steps should be taken for the Budget Bureau to realize that point.

Mr. DODD. Let me answer that in this way, if I may: Very frankly, I didn't understand the gentleman's observations yesterday when he indicated that his program had been cut off. Prior to World War II, the Bureau of Mines in total was operating on around $3 million a year, and during the progress of World War II there was a very rapid rise, on an emergency basis of funds flowing into the Bureau of Mines. Actually, with the defense military requirements, dollars were looked at secondly. The thing was to get the job done.

At the end of World War II, it became necessary to somewhat stabilize things, to get back to a normal peacetime operation. There were a number of things which were dropped back. I would say this, that in the Bureau of the Budget I think there has been a very definite recognition of the need for doing in peacetime, research which is going to benefit the national defense and the economy of the country, when a well-developed program can be put into operation and carried forward at a saving in funds rather than wasting it in hurry-up expenditures during a national emergency.

Mr. ADLERMAN. I don't think you will get much of an argument from anybody on that. Let me ask you this: Do you handle the Defense Production Act budget also?

Mr. DODD. No, sir.

Mr. ROUHANA. We review that in our Division.

Mr. ADLERMAN. Under the Defense Production Act budget, it is handled in very much the same way——

Mr. REDWINE. Before you proceed, I have a question.

Mr. Dodd, would you furnish us, going back for the last 10 fiscal years, starting in 1945, the requests of the Bureau for manganese research work and what they were allowed, please?

Mr. DODD. Yes, sir. For the last 10 years?

Mr. REDWINE. Yes, sir. I would like to have it year by year.

(This information follows:)

Fiscal history of Bureau of Mines manganese programs, fiscal years 1947–51

Fiscal year	Estimates submitted to the Bureau of the Budget			Approved by the Bureau of the Budget	Appropriated by the Congress	Estimated amount appropriated for manganese [1]
	Under ceiling estimate	Over ceiling estimate	Total			
Fiscal year 1947:						
Expenses, mining experiment stations	$2,649,385		$2,649,385	$1,855,000	$1,430,615	$55,000
Investigation and development of domestic mineral deposits, except fuels	5,000,000		5,000,000	2,400,000	1,700,000	200,000
Metallurgical research and pilot plants	5,000,000		5,000,000	2,000,000	1,000,000	145,000
Economics of mineral industries	1,972,957		1,972,957	1,190,000	850,000	15,000
Total, 1947	14,622,342		14,622,342	7,445,000	4,980,615	415,000
Fiscal year 1948:						
Expenses, mining experiment stations	1,931,000		1,931,000	1,600,000	1,060,000	30,000
Investigation and development of domestic mineral deposits, except fuels	2,018,000		2,018,000	1,600,000	1,060,000	150,000
Metallurgical research and pilot plants	2,019,000		2,019,000	1,600,000	1,000,000	95,000
Economics of mineral industries	1,592,000		1,592,000	1,233,000	680,000	15,000
Total, 1948	7,560,000		7,560,000	6,033,000	3,800,000	290,000
Fiscal year 1949:						
Expenses, mining experiment stations	1,106,800	334,000	1,440,800	1,415,000	1,415,000	25,000
Investigation and development of domestic mineral deposits, except fuels	1,756,660	158,000	1,914,660	1,750,000	1,560,000	200,000
Metallurgical research and pilot plants	1,011,330	1,600,000	2,611,330	1,895,000	1,460,000	70,000
Economics of mineral industries	753,480	25,000	778,480	769,900	769,900	15,000
Total, 1949	4,628,270	2,117,000	6,745,270	5,829,900	5,204,900	310,000
Fiscal year 1950:						
Expenses, mining experiment stations	1,620,000	283,550	1,903,550	1,409,000	1,400,000	50,000
Investigation and development of domestic mineral deposits, except fuels	2,112,760	500,000	2,612,760	2,000,000	2,000,000	600,000
Metallurgical research and pilot plants	1,859,500	637,800	2,497,300	1,810,000	1,810,000	160,000
Economics of mineral industries	1,598,170	44,560	1,642,730	1,100,000	965,000	20,000
Total, 1950	7,190,430	1,465,910	8,656,340	6,319,000	6,175,000	830,000
Fiscal year 1951:						
Conservation and development of mineral resources:						
Ferrous metals	1,927,313	781,290	2,708,603	1,937,406	2,143,140	1,089,250
Construction	600,000		600,000	600,000	600,000	600,000
Total, 1951	2,527,313	781,290	3,308,603	2,537,406	2,743,140	1,689,250

[1] Prior to fiscal year 1951, Bureau of Mines operations were conducted on a functional basis and appropriations were made to the Bureau under functional headings. Therefore, the amounts shown for fiscal years 1947 through 1951 are estimates only.

Bureau of Mines funds[1] for manganese work, 1947 through 1955

Year	Metallurgical research and pilot plants	Investigation of domestic mineral deposits	Expenses, mining experiment station	Economics of the mineral industry	Conservation and development of mineral resources	Construction	Total
1947	$145,000	$200,000	$55,000	$15,000			$415,000
1948	95,000	150,000	30,000	15,000			290,000
1949	70,000	200,000	25,000	15,000			310,000
1950	160,000	600,000	50,000	20,000			830,000
1951					1,089,250	600,000	1,689,250

[1] Prior to fiscal year 1951, Bureau of Mines operations were conducted on a functional basis and appropriations were made to the Bureau under functional headings. Therefore, the amounts shown for fiscal years 1947 through 1951 are estimates of expenditures only.

Fiscal history of Bureau of Mines manganese programs, fiscal years 1952–56

Fiscal year	Estimates submitted to the Bureau of the Budget			Approved by the Bureau of the Budget	Appropriated by the Congress
	Under ceiling estimate	Over ceiling estimate	Total		
1952	$1,204,610	$58,000	$1,262,610	$1,204,610	$1,182,055
1953	548,110	78,000	626,110	588,675	588,675
1954	853,134	350,000	1,203,134	975,861	869,415
1955	869,415		869,415	797,415	786,565
1956	786,565		768,565	786,565	

Mr. ADLERMAN. Under the Defense Production Act, is the budget handled very much in the same way?

Mr. ROUHANA. It operates a little differently, although the same basic principles prevail, the fiscal policy and Administration's keeping with it.

In the case of the borrowing authority, under title III of the Defense Production Act, it has been interpreted that this fund could be used for research. Unfortunately, this interpretation somewhat overlaps the authority of the Bureau of Mines to conduct research under section 7 of the Stockpiling Act. For this reason, we in the Budget Bureau have taken extreme care to avoid a duplication of effort because of two separate means of financing and two separate authorities, and also to avoid an augmentation of agency appropriations.

The authority in the Defense Production Act is so broad that any agency in Government might come in and request research money in support of defense objectives.

In order to assure proper utilization of the Defense Production Act funds, we established a procedure for the clearance of research projects especially, to meet those two points.

I might read the steps that are covered in the clearance of a research project proposed for financing under the borrowing authority. Each project must be documented individually by the agency, showing in sufficient detail the following:

1. Necessity, coverage, and objective of the project.
2. Whether the research is to be conducted by a private or governmental agency.
3. The advice of the National Academy of Sciences as to (a) the sufficiency of research currently being conducted in this particular field; and (b) the advisability, character, and potentiality of the proposed additional research.

4. The amount of funds required from the Defense Production Act borrowing authority, and the estimated repayments to the Government, if any.
5. The reasons why other research funds, such as those available to the Department of Defense, Department of Agriculture, Bureau of Standards, Bureau of Mines, and so on, cannot effectively be used in lieu of the Defense Production Act borrowing authority.

That is the key point. Thus far, I think we can safely say that all projects which have come into the Bureau proposed for financing under the Defense Production Act and which have complied with this procedure have been approved.

Mr. ADLERMAN. You mean to the Bureau of Mines?

Mr. ROUHANA. No, to the Bureau of the Budget. These come directly to the Bureau of the Budget because they are within a program initially certified by the ODM under the Defense Production Act as being essential to defense. Within the overall manganese program certified by ODM is a specific limitation for research. For research on manganese, the ODM had certified contracts valued at $8,893,000.

Mr. ADLERMAN. For manganese?

Mr. ROUHANA. For manganese.

Mr. ADLERMAN. Under what period?

Mr. ROUHANA. This is from inception to December 31, 1954.

Mr. ADLERMAN. Inception?

Mr. ROUHANA. Since whenever the Defense Production Act was enacted. The contracts thus far executed by GSA have a gross value of $6,751,000. So there is now available under this present ODM certification $2,142,000, available for new research proposals that may comply with this procedure.

Mr. ADLERMAN. That is limited to manganese?

Mr. ROUHANA. This is only manganese we are speaking of.

Mr. ADLERMAN. Is this the way it works: A proposition is put before the General Services Administration, which administers the research programs under the Defense Production Act; GSA refers it to the NationalAcademy of Sciences for their appraisal and approval. Is that right?

Mr. ROUHANA. That is right.

Mr. ADLERMAN. It comes back to GSA and is then referred to the Budget Bureau for their approval?

Mr. ROUHANA. That is right.

Mr. ADLERMAN. From there, it goes back to GSA and they make the contract?

Mr. ROUHANA. That is right.

Mr. ADLERMAN. Do you go behind the National Academy of Sciences' appraisal or approval of the thing and take your own technicians and say, "Here, look at this and see whether or not you find that the National Academy of Sciences are right or wrong"?

Mr. ROUHANA. No, sir; we do not check these research projects from the technical standpoint. As Mr. Dodd said, we do not have metallurgists on the staff of the Budget Bureau.

Mr. ADLERMAN. Can you tell me why it goes back to the Bureau of the Budget?

Mr. ROUHANA. It is primarily for the apportionment of the funds. The borrowing authority is a lump sum made available to the President. He has delegated his authority to allocate this fund to the ODM, with a proviso, which requires the agency which has received the authority to borrow from the ODM to come into the Bureau of the

Budget and get the funds apportioned before expenditure. This is normal procedure, just like on an appropriation.

Mr. ADLERMAN. Has the Bureau of the Budget denied any of the GSA requests for research programs?

Mr. ROUHANA. I do not think in the 3 years that I have been connected with the program we have ever denied a project.

Mr. BROADBENT. We normally require a justification for everything, just like the Congress. In connection with that we probably have questioned the Academy of Sciences because of some question an individual examiner may have in his mind, but I do not think we have turned one down.

Mr. ROUHANA. We have never turned one down.

Mr. ADLERMAN. Have you ever found that the justification has not come through or they have not been able to justify their positions?

Mr. ROUHANA. There have been very few which have been held up for any lack of justification. I want to make one other point on the clearance when it gets to the Budget Bureau for apportionment purposes. If we take the area of manganese, we know that the Bureau of Mines has been in the business for a long time. When the answers to these questions come in from GSA, if they are not explicit enough or specific enough, we would check with the Bureau of Mines just to be doubly sure that they have not done this research in the past, that it is not now being done, and that it could not be fitted into their current program by, say, dropping out a project of lesser priority. If someone comes up with a brand new idea that looks as though it has real potential, we might prevail upon the Bureau of Mines to take on this contract with its own appropriated funds rather than use the borrowing authority.

Mr. ADLERMAN. Do you know whether or not GSA consults with the Bureau of Mines before they send it over to the National Academy?

Mr. ROUHANA. It is part of the process, I think, for GSA to consult with the Bureau of Mines, and possibly Defense, and any other agencies depending upon the specific project involved. If it happened to be research in titanium, they would check with Defense, I am sure, to be sure that the $6 million being spent by Defense did not already cover the same thing.

Mr. REDWINE. By what authority does the Budget Bureau regard the Academy of Science as a supreme court in this thing, that they have to pass on it favorably before you approve a request? What is the authority for that, or is it just a practical matter?

Mr. ROUHANA. Well, it is a little bit of both. As we said, we are not technicians in the Bureau. We try to go to the people who are the technicians to get the best advice. In the case of manganese, the best technicians we know are the people in the Bureau of Mines and those made available through the Academy of Sciences. We want to be sure that this is a worthy project and not just a boondoggle. The other part of it is that as a general policy, because of the intepretation that the borrowing authority could be used for research, a policy letter was issued which included a requirement for clearance with the National Academy of Sciences. This came out of the White House.

Mr. REDWINE. My reason for asking that was that we had a witness from the Academy of Sciences today, and he did not know anything about manganese, and he frankly admitted that.

Mr. BROADBENT. The Academy of Sciences, of course, has broad authority under which they can employ any people they want.

Is there a Bureau of Mines representative here?

You see, I do not recall whether the gentleman is still the secretary or executive officer of that council, but Bill Ruby of the Geological Survey, I think he was considered quite a mineral researcher. If he is still down there, he is quite good and would know where to go. But there have been occasions where outsiders have come in and discussed these things. We do not operate in an ivory tower any more than we have to.

Mr. ROUHANA. It is the Academy of Sciences operating through the Metals and Minerals Advisory Board. Presumably, if they do not have people to make an observation, they will get the right people.

Mr. ADLERMAN. Does the Bureau take cognizance of the importance of the research? Do they examine into it in the way of the need for the research?

Mr. BROADBENT. We think so.

Mr. ROUHANA. I would like to also stress that the policy on research programs is set by ODM. As I have just indicated, ODM has given an authorization of $8 million to GSA for research contracts. All we have tried to do is to coordinate, to be sure there is no augmentation from an agency appropriation, or to be sure there is no duplication of effort. It is just a double check.

Mr. ADLERMAN. Do you work on things other than research programs?

Mr. ROUHANA. Myself?

Mr. ADLERMAN. Yes.

Mr. ROUHANA. We handle the entire budget for the stockpile, all 75 materials of it.

Mr. ADLERMAN. And Mr. Broadbent the same?

Mr. BROADBENT. In the Commerce and Finance Division, we have some 26 agencies. We have the Post Office Department, Treasury, Justice, Commerce, GSA, Housing, and then we have a number of independents, like the Federal Communications Commission, and so forth.

Mr. ADLERMAN. Which of them go into research programs besides GSA?

Mr. BROADBENT. The Smithsonian Institution has research, GSA has some, the Bureau of Standards has them. I happen to be trained as a biologist. I was a forester, originally, until I strayed off the path. I started out in agriculture. I handled agricultural research projects for quite a few years at the Budget, and did quite a few projects in my youth.

Mr. ADLERMAN. Do you handle other agencies, Mr. Dodd?

Mr. DODD. Yes. The unit under me is responsible for all the Interior Department except the Bureau of Reclamation and the power agencies, and the entire Department of Agriculture, which has a substantial amount of research in it.

If I might answer just a little more fully your question as to the interest of the Bureau of the Budget in research, I think the record will prove that we have been rather cognizant of the need for it in any of these agencies, with recommendations consistent, of course, with the over-all fiscal policy.

There is one thing that we attempt to develop in research, whether it be on manganese or in other things. That is especially when some new thing comes up. The question put to them simply is, Where have we been, where are we, and where are we going? I think we get from the scientists general agreement that a lot of research in the long run pays no dividends. You run up blind alleys. An agency will come in and request funds to start a project. One of the things we are concerned about is how long this project will run, because we do want to know something of the beginning and terminal facilities involved.

They will say 2 years, 3 years, or 5 years. We check in the following years to find out what progress they are making. But at the end of the 3-year period, if they say, "We haven't got the answers" it is not necessarily cut off. At the end of that 3-year period, also, instead of 1 prong to that tree, it may have developed 5 prongs, and they have to go out these various avenues. So we attempt, as I said earlier, to be as objective as possible in following this thing through. There is no prejudice, I would say, existing in the Bureau of the Budget against research.

Mr. ADLERMAN. I do not know whether the Defense Production Act will be extended. I hope it is, but if it is not, research is going to be in a bad way, particularly mineral research.

Mr. BROADBENT. There has been a tremendous lot financed under this act. There is no doubt about that.

Mr. ADLERMAN. When you consider eight or seven hundred thousand dollars a year as a research fund, that is very, very, small in view of the amount of research that has to be done. Let me ask you this: Suppose the Congress were to enact a special bill, and call for the expenditure of X number of dollars to do this specific research job, does that still come before you folks?

Mr. BROADBENT. The bill?

Mr. ADLERMAN. After the authorization were passed?

Mr. BROADBENT. Yes.

Mr. ADLERMAN. It would come to you the same as the Defense Production Act?

Mr. BROADBENT. That is right. It would come before us in connection with any budget estimate. The authorizations are recognized and an attempt is made to follow them as they represent the will of Congress. Sometimes the full amount is not sent up the first year, although in most cases it is.

Mr. ADLERMAN. It will come before you the same way as the Defense Production Act?

Mr. BROADBENT. Yes, sir.

Mr. HOLDERER. One of the big obstacles in the efficient conduct of research is the need to ask for a yearly appropriation. There are a good many reasons why you cannot accumulate a good staff on that basis. No good man is going to take a job with a Government research program if he thinks at the end of the year the thing may be washed up. He has 50 good jobs waiting for him right now in industry when he graduates this coming June where he knows the job is good for 5, 10, or 15 years, or a lifetime, if he wants it that way. What can we do, pinning ourselves down to manganese in particular? Suppose the Congress passed a bill calling for a research program with X millions of dollars for manganese. It would be perfectly silly to set up a

program like that and put it on a yearly basis, because you would never get anywhere. We have had 3 or 4 research programs that have fallen flat. You heard just a moment ago this Mangaslag job, a million and three quarters or almost $2 million, a job that should have gone ahead but the money ran out and that is it.

There are 2 or 3 other jobs that have fallen flat for the same and other reasons, Is it possible to set up a job, let's say giving it a 5-year time limit? I do not approve of a job going on forever, because that breeds ineffciency, too. Is it possible under our system of Government to set up a job and not have to come back and beg for a dime at the end of every year?

Mr. BROADBENT. I would answer it this way: There are research programs that have been carried on under the auspices of the Federal Government as well as the States that have gone on year in and year out. Agriculture, Bureau of Standards, and so on, are concerned there.

I do recognize that they have had their ups and downs, and I think also that it is difficult to carry on a planned research project that you project over 5 years or 7 years, or what have you, and not have the wherewithal to carry that out once you start.

By and large, the Federal research programs have sustained themselves pretty well. I remember in 1940, and I was working on the Department of Agriculture estimates in the Budget Bureau, some of the men in the research agencies expressed fear that we are going into a war situation and they would be forced to reduce their budget estimates and appropriations and so on. Well, I happened to look back to World War I. We had a series of budget digests down there that show the financing of programs since their inception, with some of them going back to 1890. Many of those research agencies in the Department of Agriculture carried about the same level right through World War I. World War II came along and while some of theirs were reduced somewhat, in many cases it was because their younger men went into the Army.

But they were given additional funds from other sources. Some of them pretty nearly doubled their program, and some of the others tapered off, too. But I think in the case of manganese, everyone seemed to lose interest in it every once in awhile. You have to have that sustained interest to hold it up, and because of priority allocations the thing dropped between the cracks, probably, and perhaps erroneously so. But it is possible under our present system to set up a research program and finance it and carry it out, providing, of course, the Budget approves it as well as the Congress.

After all, the Congress is running the country and we are not. Once in awhile we get a little overenthusiastic, perhaps, but we do not mean to.

Mr. HOLDERER. Every little individual project, taking, for example, the many scores of projects that DMPA had, each little project had to come to you for review, did it not, or at least O. K.?

Mr. BROADBENT. O. K. on the financing side; yes. In those cases, in I guess most of them, the ODM set the pattern there, I think, and we did the bookkeeping. Once in awhile we did raise a question to be sure that everybody understood what was going on.

Mr. HOLDERER. After you have O. K.'d the apportionment of the funds, you no longer have a continuing interest in that, do you?

Mr. ROUHANA. We do have an interest in followup, to see that the project is progressing. We keep tabs on it to be sure or to at least anticipate additional requirements of funds and to find out how much more we are going to pour into this if it is a boondoggle, or, if it really has potential, can we pour a lot more into it. We have a continual followup and we do get these progress reports issued by GSA on the research projects, to let us know what the status is, what the expected date of completion is, and what the potential is.

I might say under the Defense Production Act, I do not think there is an annual limitation on the length of the contract.

Mr. ADLERMAN. I would like to ask one more question. What programs are being held up at the present time? What research is being held up for further justification?

Mr. ROUHANA. There is one manganese project.

Mr. ADLERMAN. Which one is that?

Mr. ROUHANA. The Bruce Williams Co. project.

Mr. ADLERMAN. Is that being held up for justification?

Mr. ROUHANA. Yes, sir. We have tried to get the Bruce Williams people to talk to the Bureau of Mines about the technical details of the process, to be sure that the Bureau of Mines has not already conducted experiments in this field, is not now doing it, or could not finance it out of 1955 or 1956 funds, since they have $800,000 roughly in the 1956 Budget, and this project might be financed out of their normal appropriations which are available for research in manganese, generally.

Mr. ADLERMAN. Do you mean in the Bureau of Mines?

Mr. ROUHANA. The Bureau of Mines.

Mr. ADLERMAN. Have they not exhausted their research funds?

Mr. ROUHANA. They have committed most of it for this year; yes. But in the fiscal year of 1956, an $800,000 increment is not committed.

Mr. BROADBENT. Is it fair to say that in that contract it had not cleared through this established procedure?

Mr. ROUHANA. Unfortunately not.

Mr. ALDERMAN. Do you mean it had not come in the proper form?

Mr. ROUHANA. There were no reasons given as to whether or not this same kind of research had ever been tried before by the Bureau of Mines or whether or not the Bureau of Mines could not fit it into their normal program rather than use the Defense Production Act funds for it. I understand that there is an attempt being made to get Mr. Williams to talk to the Bureau of Mines, to give them a general idea of what is involved in his process so that the Bureau of Mines can give us a judgment as to whether or not this has been done before or could not be fitted into its program for 1956.

Mr. ADLERMAN. As soon as they do that, you think it will go through?

Mr. ROUHANA. There is no question.

Mr. REDWINE. That contract is the only one pending?

Mr. ROUHANA. So far as I know on manganese; yes, sir.

Mr. REDWINE. I have one other question. You heard this earlier witness this afternoon talking about the Mangaslag contract?

Mr. ROUHANA. Yes, sir.

Mr. REDWINE. He said it was terminated at the end of December, I believe, 1954, after $1,400,000 of Government money had been spent.

What is the usual procedure? Is there an examination made, a re-evaluation made to see whether that should be a supplemental contract or a project of that kind, or just what is the procedure on that? I do not mean that particular case, but I was using it as a case in point.

Mr. ROUHANA. As a general rule, the Budget Bureau does not get involved in the specific terms and conditions of any contract. That is entirely an operating agency job, being within the purview of the GSA. If they have terminated this contract, it is because of some technical difficulty or administrative operating policy, and not because the Budget Bureau got in the middle and said, "Cut it off." I would rather that the GSA gave you the details on Mangaslag, particularly, and I think that they will verify what I have told you, that we do not follow the specific contracts on a day-to-day basis.

Mr. REDWINE. Apparently in this case, and I am not trying to pin you to Mangaslag at all, they had used up the money.

Mr. ROUHANA. I am not sure that they did.

Mr. REDWINE. I am not either. But suppose a contract has expired because the money has been used up, yet they have not gone far enough with their research to prove anything. What is the procedure then?

Mr. ROUHANA. Well, I will explain that to you.

Mr. REDWINE. Does the agency come to you for a supplemental appropriation for that particular project?

Mr. ROUHANA. Let me put it this way: If there is no money left in the certification made by the ODM, then they would have to go back to ODM and say to them, "This project is not yet complete," or, "We will require more money to complete it. Would you please increase your certification for research." After that they (GSA) would come in to the Bureau of the Budget with a justification for apportionment. That is the procedure. If there is a balance in the certification, they can come in with a request for an increase in the apportionment.

Mr. REDWINE. I was just trying to get what the procedure is in a case of that kind.

Mr. ADLERMAN. Is there another one being held up, the Sylvester Diamond Alkali?

Mr. ROUHANA. It has not reached the Budget Bureau to my knowledge.

Mr. ADLERMAN. Have you had anything on it at all at this time?

Mr. ROUHANA. No, I have just read about the process or the project in the report issued by the GSA.

Mr. ADLERMAN. That is still in GSA?

Mr. ROUHANA. That is right.

Mr. ADLERMAN. Or the Bureau of Mines?

Mr. ROUHANA. Yes, sir.

Mr. HOLDERER. Do you recall Westmoreland Manganese in Batesville, Ark.? I think that was a pure chance contract.

Mr. ROUHANA. That is right. I think there was a press release issued by GSA. I think I can find it for you here.

Mr. BROADBENT. Everything we have would be second hand.

Mr. ROUHANA. That is right. There was a press release issued by GSA in November 1953, stating that the contract was canceled. I do not know the details of why it was canceled. Maybe it was a default or some other reason.

Mr. HOLDERER. That was not one of your jobs?

Mr. ROUHANA. No, sir.

Mr. ADLERMAN. Thank you very much. We appreciate your coming down.

Mr. ROUHANA. You are welcome.

Mr. ADLERMAN. Mr. Sylvester?

STATEMENT OF GEORGE R. SYLVESTER, PRESIDENT, SYLVESTER & CO., CLEVELAND, OHIO

Mr. ADLERMAN. Do you have a prepared statement?

Mr. SYLVESTER. Yes, but just a single copy of it.

Mr. ADLERMAN. Would you state your name for the record and your connection?

Mr. SYLVESTER. My name is George R. Sylvester, and I am president of a small Cleveland company known as Sylvester and Co. I have this statement. Should I read it?

Mr. ADLERMAN. Yes. Would you read your statement and proceed in your own way?

Mr. SYLVESTER. Mr. Chairman, it is a real pleasure to speak to your committee and convey to you my ideas and opinions concerning the manganese question and how it may be solved, using domestic sources of material.

The business of our small company may be divided into two parts, the first of which consists of the designing and construction of industrial furnaces for the chemical, metallurgical, and ceramic industries. The second portion of our business is concerned with the development of processes for the extraction of various strategic materials from their natural ores. My remarks on manganese are based upon our experience in the process phase of our business.

During the last 10 years, in addition to manganese, we have worked on other strategic and necessary materials. Among these are beryllium, zirconium, magnesium oxide, chromium oxide, titanium salts, and to a limited extent, the extraction of some of the rare earths from monazite sand.

Being a small company and having sharply limited finances we were not able to pursue all of these activities through expensive pilot plant operations, but we did manage to carry the manganese, beryllium, and zirconium processes through their pilot production stages.

After the pilot work, a corporation was finally established with private capital to use our zirconium extraction methods to commercially produce various grades of pure and stabilized zirconium oxide. This plant is now in commercial production, using methods very similar to that of our manganese recovery process.

Similar attempts to commercialize the very strategic beryllium extraction process met with little success in the United States, but we were successful in helping to establish a commercial operation in Brazil. Both of these operations did not require large amounts of capital, since the production was small and the equipment needs were quite modest. Manganese recovery presents an entirely different problem. The plant equipment must be geared to large-scale production in order to demonstrate the practical nature of it for an industry the size of our steel business. Such equipment represents

a very sizable capital investment, and there is no hope of a small concern such as ours ever being able to finance such a project.

Because of this financing problem, after our laboratory work had been completed to the point where the principles of the process were proven beyond a reasonable doubt, most of our efforts were spent in attempting to obtain financial support from the steel industry or from agencies of the United States Government. This presented problems far more difficult for us than the technical problems involved in the process itself. We had a very definite feeling that much critical time was being wasted, which in case of national emergency could become most serious, but somehow we were unable to convey our sense of urgency to others who might be of help to us.

When the Cleveland newspapers first announced our process, we were requested by Bureau of Mines to discuss the details with them. This we were glad to do but immediately met a spirit of opposition because the Bureau of Mines had a favored process of their own which they were recommending to both Government and industry to the exclusion of other methods which might be presented to them.

Nine months later, we were able, after much negotiations, to obtain the Bureau of Mines' agreement to a small continuous-scale trial in equipment at their station in College Park, Md. Experimental work was finally started in August of 1950, and, after approximately 8 months, the results obtained showed conclusively that our methods were technically feasible for the recovery of manganese and iron concentrates from waste steel mill slags or similar siliceous materials.

After this demonstration, we began to feel that a prototype large-scale plant could be established for commercial and economic demonstrations of manganese recovery.

Financing for the commercial plant never materialized for several significant reasons. Private support of a commercial operation was well under way, when inquiry by the financial backers at the Bureau of Mines discouraged them to an extent that they finally withdrew. At this time, the Bureau of Mines was doing everything possible to promote the commercial utilization of a process developed by one of their own personnel and sponsored by them. Government financial support of our activities was repeatedly delayed by recommendations of the same group that the laboratory work be redone. All in all, it seemed that definite and concrete attempts were being made in every possible manner to discourage us and other independent research companies from continuing our work on the manganese problem.

Five years have been spent in constant negotiations with various Government departments and in addition over $100,000 of our own limited funds have been expended to bring our process to its present state of development. Finally the matter is receiving the favorable and expert attention of Mr. Clarence Fredell and Mr. Carrel Larsen of Emergency Procurement Service, whose efforts have been invaluable in restoring the prospects of Government support for independent research to pilot efforts. Negotiations for a small research and development contract with Emergency Procurement Service are currently under way and that agency is making every effort to accelerate the domestic manganese program and thus save time which can never be reclaimed.

Fundamentally, I am not in favor of stockpiling manganese because I feel it is a poor substitute at best. It can be very expensive, and

definitely it does not solve the problem. Who is to say what the tonnage should be or how long an emergency might last? If only a small portion of the money spent on stockpiled manganese ores had been spent to vigorously push research for the recovery of domestic materials, surely the problem would have been solved by now.

MANGANESE STOCKPILE SHOULD BE USABLE GRADE

However, since we do now have a low-grade stockpile, representing a lot of money, it should be brought up to a usable grade, unless the cost of so doing involves more than it is worth. Even then, if it is a vital part of our insurance program, it should be ready to use at a moment's notice, if it is to have any real value in case of sudden emergency. Possibly it should be converted to its final form of ferromanganese.

I am not too familiar with the chemical constituents and mineral forms of the low-grade domestic ores which have been purchased for the stockpile. The fact that these ores must be upgraded before they can be used in commercial furnaces is a matter of general knowledge, but whether our process is suitable for them is something we do not know. We do know it can upgrade silicate ores. Possibly these stockpiled ores may be raised to a commercial grade by physical separation methods, whereby the gangue rock can be separated from the manganese-containing constituents. If further upgrading is needed, we would be most happy to try to apply our methods to help make this stockpile usable commercially.

It would seem that all attempts in the past by both Government and industry have been along the line of obtaining and importing high-grade ores. Since our steel industry consumes approximately one and one-half billion pounds of metallic manganese annually, it would seem to be a never-ending job to store sufficient high grade ore so that these requirements could be met over any lengthy period of national emergency. This job can be solved by our own low-grade domestic supplies, if we really apply ourselves and use facts and known processes which we have already at hand.

Regarding the necessity of expanding research to learn how to use our local material, I certainly would recommend such a program. It should not be restricted to Government agencies only, but private industry should be encouraged in every way possible, financially and otherwise.

I believe the experience of the armed services has shown most gratifying results from research and development which they have sponsored and financed in private industry. After all, our country, the envy of the world, has grown around the private enterprise system. It was brought out several times in testimony yesterday, that manpower available in Government reasearch agencies was often limited by salary rates and other fixed conditions.

Our country certainly should take advantage of the many very competent engineers and scientists who are employed by industrial and research concerns. The most remarkable development of modern times, the unlocking of atomic energy, was made possible by the cooperation of thousands of technical and engineering people, most of whom were employed by private industry. For these reasons, I would certainly suggest that all projects for the utilization of our domestic

manganese supplies be given every possible aid that our Government can arrange, regardless of how or where they originated.

It is apparent, when domestic supplies are evaluated, that in addition to western ores, three major sources should be considered for a long range program. These are the Cuyuna Range, Minnesota, manganiferous iron ores which are being currently used by industry; the Aroostook County, Maine, deposits which are estimated to contain approximately 16 million tons of manganese in a 9 percent concentration; and waste steel mill open-hearth furnace slags. Of the three, slags can be considered as our greatest potential source of manganese, since approximately 11 million tons of slag, containing almost 1.5 billion pounds of metallic manganese, are produced each and every year by the steel industry in their normal manufacturing process.

This will continue as long as steel is being made from manganese containing iron ores. The manganese contained in the slag is derived from the small percentage contained in our domestic iron ore, and as the Canadian iron ores, with their higher manganese content, come into use, even greater quantities of manganese will be found in the wasted slags.

Fortunately, the 170 million tons of natural ore in Aroostook County, Maine, being silicates, have almost the same processing characteristics as the waste slags; so the facilities designed for the treatment of slags can be used without change for the extraction of manganese and iron from Aroostook County ores.

From the above figures, it is apparent that, when properly recovered, manganese from slag can supply almost the entire requirements of our steel industry, and when supplemented with natural domestic ores, our country need no longer be concerned with overseas shipments of this very essential steel making material.

As long as foreign ores are available and are cheap, industry will continue to use them. They will not risk capital to develop possibly more expensive domestic supplies until present overseas sources are choked off, or until it is conclusively shown that domestic manganese can be recovered profitably in free competition with foreign ores. At least 18 months will be required to construct a plant and another year will be needed to prove its operation and demonstrate its economy. While time is still on our side, the risk is small and the rewards are enormous.

In order to demonstrate our self-sufficiency in manganese and to provide indisputable evidence for industry, we would most strongly suggest the erection of a large-scale prototype plant, which could be used as a guide for the construction of additional plants to free us once and for all from foreign manganese supplies. Our process, together with others, is capable of doing that job now.

While a fair amount of research has been done in the past, some with very promising results, we think expansion of these results should be sponsored on a much larger scale, so as much time can be saved as possible.

It seems that I never have been able to convince enough people that, even though countries such as Brazil and others, are friendly, still products from them must reach the United States by water. While I do not have the figures at hand, I have seen information in the past which indicated that a large proportion of our manganese carrying ships were sunk at the beginning of World War II. Espionage is

such that our enemies always seem to know which vessels are carrying the most strategic materials. Surely, dollars spent now would not be too much to pay to save the lives of sailors who might be lost in delivering foreign ores to our country in time of war.

Aside from the emergency aspects of the manganese situation, development of recovery methods would provide an entirely new industry for our country, with resultant additional employment. The utilization of waste materials is always of economic benefit, and in this case a material now thrown away might eventually serve to reduce to some extent the overall price of steel.

In conclusion, we feel the only solution to the manganese problem is one which will completely eliminate the necessity of stockpiling. From an economic standpoint, I, of course, would recommend that necessary research work be carried on to upgrade and utilize the present stockpile. In addition, I believe that proven domestic reserves of low-grade ores and waste slags which are produced every day can easily satisfy our national requirements. The problem would seem to be one of utilization of these latter sources with the greatest possible expediency.

There are a few more extraneous remarks I would like to make. One, in listening to this testimony yesterday and today, there seems to be some confusion on interlocking of research and development. To me, research is a small-scale operation. It is a test-tube operation. I believe on that basis, there are a lot of processes which have good technical feasibility.

From that point on, it is one of engineering rather than research. It is the job of applying the test tube or toy sized equipment, to large-scale use, since this manganese industry is a tremendous industry. It is as big as the portland cement business, or it is almost as big, or in its entirety may be as large as the taconite industry. So the job of obtaining domestic manganese is one of doing a tremendous amount of engineering in sizeable equipment. I do not mean that all of the plants should be built that are necessary to make us self-sufficient at this time, but certainly we should have enough prototype plants to indicate the direction in which we are going, so that time can be saved in case of an emergency.

I think the methods that are going to be used should be suitable for large-scale production. In our own case, we use methods which are not new with us. They are in use in other industries all the time. The crushing and grinding of slag is not difficult. The sintering operation in a rotary kiln is not as difficult as that daily accomplished in the portland cement field. Our magnetic separation job is certainly no more difficult than the taconite separation job. But it does require large scale equipment and considerable capital in order to prove it.

We also think that any process should very definitely not use strategic materials which might be very short in time of war. Whether those materials be metallurgical coke or whether they be scarce chemicals, we think for an industry the size of the manganese business, the materials that go into it should be as common and plentiful as can be found.

Mr. REDWINE. Mr. Sylvester, would you please identify for us the process of the Bureau of Mines that you say they are pushing?

Mr. SYLVESTER. The one that Mr. Matheny mentioned, called the Royster or Mangaslag process. We ran into that roadblock from the time we first started until the present.

Mr. REDWINE. Does that slag process use tremendous quantities of coke?

Mr. SYLVESTER. Yes, it does.

Mr. REDWINE. How does that tie in with your observation a moment ago about the use of strategic materials needed by the manganese industry?

Mr. SYLVESTER. My honest opinion is that open-hearth slag smelted in a blast furnace will utilize tremendous quantities of coke, regardless of how it is done, regardless of what type of blast furnace is used, whether it is a high-temperature furnace or low-temperature furnace or of special design.

If my memory is correct, during World War II, we were extremely short of metallurgical coke. The coke rates that I have seen published used in the smelting of slag have been considerably higher than the coke rates used in normally smelting ferromanganese ores in the blast furnace. So that means additional use of coke. In our own process, we do not use coke. We can use any type of fuel, anything to heat a rotary kiln, whether it be powdered coal, oil, natural gas, coke oven gas, any fuel that may be available.

Mr. HOLDERER. Do you now have associated with you any large concern with an engineering staff?

Mr. SYLVESTER. Yes. In order to facilitate and expedite the operation as much as possible and in line with my previous comments, we feel that industry has a tremendous number of engineers and scientists available, most of them, of course, tied up with various companies. In our own connection, we have made arrangements with the Diamond Alkali Co., to work in partnership with us. In fact, we have arranged that part of their facilities be used for this proposed operation that we have before EPS at the present time. They are agreeable to it.

Mr. HOLDERER. How much money are you asking for?

Mr. SYLVESTER. A total of about $680,000 for a program to run 15 or 16 months.

Mr. HOLDERER. Is Diamond Alkali prepared to put up any?

Mr. SYLVESTER. No. Diamond Alkali is doing it without profit. It is a nonprofit contract, and they have agreed that their books shall be audited, that their overhead charges or labor charges will be exactly the same as they have in their normal business. There is no profit on it at all. They are doing that primarily because they think it has a commercial future.

Mr. ADLERMAN. They are allowing you to use part of their plant, is that correct?

Mr. SYLVESTER. Yes, sir.

Mr. ADLERMAN. They are furnishing part of their plant?

Mr. SYLVESTER. Yes, sir.

Mr. ADLERMAN. And what are they charging for that?

Mr. SYLVESTER. They are charging less than normal rates as far as depreciation.

Mr. ADLERMAN. Does that include the equipment and all?

Mr. SYLVESTER. That includes the equipment and all. It includes many facilities in a large plant which cannot easily be evaluated, such

as hospital services and health facilities, plant protection, roadways, utility supplies, water systems, power systems, fuel systems.

Mr. ADLERMAN. You are using a magnetic type separation somewhat similar to the type that Mr. Knapp described earlier today?

Mr. SYLVESTER. Yes, sir, a high intensity separating system manufactured by Jeffrey Manufacturing Co., known as the Steffensen Separator. It is currently being used, I think most generally, in the taconite field.

Mr. ADLERMAN. Thank you very much, Mr. Sylvester.

I think we will now adjourn until tomorrow morning at 9:30.

(Whereupon, at 4:30 p. m., the hearing was recessed, to reconvene at 9:30 a. m., Thursday, April 14, 1955.)

UTILIZATION OF THE MANGANESE DEPOSITS IN THE UNITED STATES

THURSDAY, APRIL 14, 1955

UNITED STATES SENATE,
MINERALS, MATERIALS, AND FUELS SUBCOMMITTEE
OF THE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS,
Washington, D. C.

The subcommittee met, pursuant to recess, at 9:30 a. m. in room 224, Senate Office Building.

Present: Senator W. Kerr Scott, North Carolina; George W. Malone, Nevada.

Also present: Jerome S. Adlerman, chief counsel of the subcommittee; George B. Holderer, staff engineer; and William C. Broadgate, metals and minerals consultant to the chairman; Robert Redwine, staff member.

Mr. ADLERMAN. I would suggest that all of you gentlemen might come up to the table.

STATEMENTS OF CLARENCE A. FREDELL, ACTING CHIEF, MATERIALS DIVISION, EMERGENCY PROCUREMENT SERVICE, GSA; HERBERT K. HYDE, ASSISTANT TO CHIEF COUNSEL, GSA; JOHN G. FORD, CHIEF CONTRACTS ADMINISTRATION BRANCH DIVISION, EMERGENCY PROCUREMENT SERVICE; M. C. ROBINSON, CONTRACT NEGOTIATOR, CONTRACTS ADMINISTRATION BRANCH, MATERIALS DIVISION, EMERGENCY PROCUREMENT SERVICE; A. L. SHERMAN, CONTRACT NEGOTIATOR, CONTRACTS BRANCH, MATERIALS DIVISION, EMERGENCY PROCUREMENT SERVICE; VICTOR ERICKSON, CHIEF, FINANCIAL ANALYSIS SECTION, RAW MATERIALS BRANCH, BUDGET DIVISION, GSA; H. V. LLEWELLYN, CHIEF, RAW MATERIALS BRANCH, BUDGET BRANCH OF THE COMPTROLLER, GSA; R. C. FLEMING, ACTING CHIEF, EXPANSION BRANCH, MATERIALS DIVISION, EMERGENCY PROCUREMENT SERVICE, GSA; AND C. B. LARSON, EXPANSION BRANCH, MATERIALS DIVISION, EMERGENCY PROCUREMENT SERVICE, GENERAL SERVICES ADMINISTRATION

Mr. ADLERMAN. Mr. Fredell, I will direct my questions to you and if you feel that there is somebody else on your staff or on the staff of GSA who can answer the question in more detail, you can refer the question to them.

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Mr. FREDELL. All right.

Mr. ADLERMAN. How long have you been with the GSA?

Mr. FREDELL. I have been with GSA since Defense Materials Procurement Agency was abolished and the functions of that agency were transferred to GSA. I believe it was August of 1953.

Mr. ADLERMAN. You are an engineer, of course?

Mr. FREDELL. That is correct. I am graduated from the Montana School of Mines, 1921, and I did graduate work in Stockholm, Sweden, and I have been in the mining industry since I first started as a mucker in Butte in 1915.

Mr. ADLERMAN. You are Acting Chief of the Materials Division?

Mr. FREDELL. That is correct.

Mr. ADLERMAN. In your prior position, you had charge of research projects on manganese?

Mr. FREDELL. Yes, in the Expansion Branch, as Chief of the Expansion Branch it is our duty to review all projects that come in.

Mr. ADLERMAN. For the purpose of the record, would you tell us the quantity of manganese on hand in the purchase depots, the location and value and average grade?

Mr. FREDELL. I would like to have a little prepared statement that I have go in the record, with your permission?

Mr. ADLERMAN. All right. Proceed with the statement.

EXPANSION PROGRAM FOR METALLURGICAL MANGANESE

Mr. FREDELL. This country is largely dependent upon foreign sources for specification grade manganese. At the present time, approximately 94 percent comes from overseas. Consequently, in the event of war we would probably be cut off from our overseas sources. In view of that condition, it was readily recognized at the beginning of the Korean conflict that every effort should be made for this country to lessen its dependence on overseas supplies. As a result, in May 1951 the Defense Production Administration authorized the Defense Minerals Administration, which is the predecessor agency to Defense Materials Procurement Agency and General Services Administration to inaugurate an expansion program for metallurgical manganese. This authorization was very broad in scope. It permitted commitments to purchase manganese from domestic and foreign sources at negotiated prices and when in the national interest at above market price. Contracts were negotiated in the United States, Mexico, Brazil and from operating mines in India. The contracts for foreign ores were let at market price, either at the time that the contract was made, or specified contract price at the time of delivery. Some of the domestic contracts were let under similar pricing.

The contracts were let and in certain cases Government financial assistance was granted in the form of loans, grants against production, long-term and floor price contracts. In addition to this program there was authorized the purchase of subgrade manganese ore at domestic source at premium prices. Under this authority purchase depots were established in localities where the most substantial quantities of manganese appeared to be available. The depots are located at Butte and Phillipsburg, Mont., Deming, N. Mex., and Wenden, Ariz. Each depot accepts manganese of domestic origin until a

maximum of 6 million long tons of recoverable manganese have been received or until June 30, 1958, whichever occurs soonest.

Subsequently, a purchase depot was established at El Paso, Tex. for the purchase of 500,000 long tons of low-grade Mexican manganese ore meeting certain specifications under individual contracts with producers in Mexico. In 1952 a carlot program was established for the benefit of small domestic producers of manganese. A small producer is defined as one whose anticipated or actual production is less than 10,000 long dry tons annually. Under the program the Government accepts plus 40 percent manganese ore in carload lots at any railway station in the country. This program is to terminate June 30, 1958, or as soon as 19 million long dry ton units have been purchased. Prices to be paid under these programs are based on $2.30 per long-ton unit for material containing 48 percent manganese subject to penalties and premiums based on analysis. The authorization above referred to also included authority to enter into research and development contracts looking to the perfection of metallurgical processes or upgrading submetallurgical ores. The reason for this is that there was no known satisfactory metallurgical process for upgrading submetallurgical ores to usable form. As a result of this authorization, contracts have been entered into for research toward improved metallurgical techniques in the hope that more of the low-grade ores would be commercially, or at least, strategically usable. One such contract is aimed at the recovery of manganese from steel mill slag piles. Five research and development contracts relating to manganese have been entered into by GSA or its predecessor agencies and currently there are three contracts under negotiation in this field.

By letter dated April 23, 1952, John R. Steelman of the Office of Defense Mobilization instructed DMPA to foster research in minerals and metals under authority of the Defense Production Act of 1950. Such research was to be pursued only when it was not already being undertaken or could not be undertaken by the Government under the stockpiling legislation or by private industry.

In a letter dated July 31, 1953, ODM instructed DMPA to avoid new commitments for purchase of manganese and to bring about a reduction of such contracts where action appeared possible and reasonable. GSA followed this directive to the extent possible.

In June 1954, GSA was instructed to curtail cancellations.

That outlines the general start of the various authorities under which we have been operating and more or less the mode in which we have been operating.

Mr. HYDE. We have prepared a chart.

Mr. FREDELL. You asked the question as to what had been purchased under these depots and I have here a chart which shows the name of the depot and the amount that was purchased at each depot. I would like to introduce that as Table No. 7. This chart does not show the average grade, but I can insert that, I just received those figures.

Mr. ADLERMAN. We will mark this in evidence.

(The document was marked Exhibit No. 1 and filed for the record.)

TABLE No. 7.—*Analysis of manganese on hand at the purchase depots as of Dec. 31, 1954*

[All quantities in terms of LDTU]

Name of depot	Recoverable units	Quantity purchased—contained units	Purchase cost	Operating expenses	Miscellaneous	Total value	Average grade
Purchase regulations:							
Butte-Phillipsburg	1,134,446	1,418,058	$1,796,127	$600,593	$19,151	$2,415,871	23.7
Deming	1,770,577	2,213,221	3,640,146	146,927	75,449	3,862,522	24.5
Wenden	4,656,433	5,820,542	8,069,646	157,396	277,994	8,505,036	24.4
Subtotal, depots		9,451,821	13,505,919	904,916	372,594	14,783,429	
Domestic small producers:							
Central office		1,287,258	2,842,336	227,097		3,069,433	
Atlanta, region 4		250,285	559,662	47,508		607,170	
Dallas, region 7		612,597	1,348,792	223,757		1,572,549	
Denver, region 8							
New York, region 2							
San Francisco, region 9		105,752	242,445	37,210		279,655	
Seattle, region 10		19,725	45,015	8,834		53,849	
Subtotal, small producers		2,275,617	5,038,250	544,406		5,582,656	
Total purchase regulations		11,727,438	18,544,169	1,449,322	372,594	20,366,085	

Mr. FREDELL. That is all I have.

Mr. ADLERMAN. Do you have any indication what grades these manganese deposits run to?

Mr. FREDELL. The deposits?

Mr. ADLERMAN. I mean the stockpiles, the purchases.

Mr. FREDELL. The depots?

Mr. ADLERMAN. Yes.

Mr. FREDELL. That is on the table I just gave you, it is at the far end and gives the average grade.

Mr. ALDERMAN. No, it is blank.

Mr. FREDELL. Let me pencil it on there.

Mr. BROADGATE. Are these recoverable units, or contained units?

Mr. FREDELL. I believe these are now recoverable units.

Mr. BROADGATE. They should be under the present regulation, but if these figures are correct for December they could not be recoverable units, they must be contained units because Wenden at the present time up to date, as I understood it from GSA yesterday afternoon, has 5,600,000 units with an intake now of 100,000 a week, so these figures would have to be recast.

Mr. FREDELL. I guess you are correct in that. These are the contained units at that time.

Mr. BROADGATE. Now, it is being bought on a recoverable unit basis?

Mr. FREDELL. The recovery amendment was not put in until the first of the year.

Mr. ERICKSON. The table here reflects the recoverable units.

Mr. BROADGATE. How can it reflect the recoverable units when Fred Witt told me at half-past four yesterday afternoon that Wenden at the moment, at the end of March rather, was 5,600,000 units and his intake this month so far has been 100,000 a week, so that the station will have to close April 30 regardless of what Mr. Fleming testified

here yesterday, or day before yesterday. Mr. Fleming and Bruce Clemmer indicated that the Wenden station could run until May 30 and the news has gone out to that effect, but when I checked the figures yesterday afternoon, the quota will be exhausted this month at the date that was previously announced. So something is wrong with these figures.

Mr. ERICKSON. I do not believe that is correct, sir, if I may say so. The exact rate of deliveries is always subject to some variation and it is not known for certain whether the deliveries will be completed by April 30 or May 30. There is always a little bit of possible variation there and the deliveries vary from day to day and week to week.

Mr. BROADGATE. I understand that. That being true, and deliveries so far this month having averaged 100,000 a week, that being so—and perhaps, being a variation, and generally they push up before they close a station—there is still something wrong because at the end of March the recoverable unit purchase was 5,600,000 and you have 5,820,000 at the end of December and it was on this figure that the December closing announcement was made.

Mr. ERICKSON. As of December 31 the cumulative contained purchases of manganese at Wenden were 5,820,000 long-ton units.

Mr. FREDELL. That is contained.

Mr. ERICKSON. That is contained. The recoverable as of the same date was 4,656,000.

Mr. BROADGATE. Right. Now, these figures should be recast in the light of the present directive.

Mr. ERICKSON. Well, I think the figures do not have to be recast. I think perhaps the caption at the head should be changed in terms of contained units.

Mr. BROADGATE. That would be all right, if the caption was properly changed, but on the basis of the present directive these figures would not be very informative unless that were done?

Mr. ERICKSON. If the table is clearly labeled to read contained unit, there will be no ambiguity, correct?

Mr. BROADGATE. That is correct, but I would like you to supplement the table with a recoverable units table.

Mr. ERICKSON. I have the figures on the recoverable units and I can give them to you for each depot at this time, if you wish.

Mr. BROADGATE. I think it would be better if you would submit a table rather than taking up the time of the committee now. I understand you gentlemen are in a hurry to get away?

Mr. ERICKSON. I would take just a minute.

Mr. BROADGATE. Go ahead.

Mr. ERICKSON. For the Butte-Philipsburg depot, the recoverable units purchased through December 31, 1954, was 1,134,446 long-ton units. The same figure for the Deming depot through December 31, 1954, is 1,770,577. The same figure for the Wenden depot in terms of recoverable units is 4,656,433.

Mr. BROADGATE. I think it is important that those figures be in the record because the closing date of these stations is dependent now on recoverable, rather than contained units.

Mr. FREDELL. That is right.

Mr. BROADGATE. Providing the quota should be saturated before June 30, 1958.

Mr. ERICKSON. That is correct, sir. You may be aware that under Public Law 206 the GSA is required to report quarterly cumulative purchases.

Mr. BROADGATE. I have those reports.

Mr. ERICKSON. The March 31 report should be out within approximately 2 weeks and we will have the most up-to-date information at that time.

Mr. BROADGATE. You will file that for the record with the subcommittee?

Mr. ERICKSON. Yes, sir.

Mr. ADLERMAN. Mr. Fredell, as you testified a little while ago, you are in charge of the research to beneficiate the domestic manganese. How many programs were instituted all together?

RESEARCH PROGRAMS ON MANGANESE

Mr. FREDELL. There are five contracts entered into.

Mr. ADLERMAN. Will you name those five contracts?

Mr. FREDELL. The Southwest Engineering Co., Manga Slag, Nossen Laboratories, Dr. L. W. King, and Manganese Chemicals Corp. At the same time we also had a contract with the National Academy of Sciences for technical services in evaluating the projects and in monitoring the projects in certain instances after they were under way.

Mr. ADLERMAN. How much was spent in the Southwest Engineering contract?

Mr. FREDELL. That contract was for $250,000.

Mr. ADLERMAN. Was that all spent?

Mr. FREDELL. I think the final figures show it was approximately all spent.

Mr. ADLERMAN. Part of that did not go for research, part was in evaluation of the survey of the Westmoreland? It was in the Westmoreland project that they did an evaluation job for you, is that not right?

Mr. FREDELL. They did an evaluation job on the Westmoreland.

Mr. ADLERMAN. That came out of the $250,000?

Mr. FREDELL. Yes.

Mr. ADLERMAN. That was not really research then, was it?

Mr. FREDELL. Well, not directly research on the original project that they were given a contract for, no.

Mr. ADLERMAN. I have here before me a table entitled "Manganese Program Table 5, Status of Research and Development Work" which contains the amount spent and some of the details, date of contract and estimated date of conclusion and some remarks. Do you want to put that into the record?

Mr. FREDELL. Yes, we would like to put that into the record.

(Document was marked "Exhibit No. 2" and filed for the record.)

MANGANESE PROGRAM

TABLE 5.—*Status of research and development work contracts under Defense Production Act borrowing authority*

Project	Description	Funds required		Date of contract and estimated date for conclusion of test work	Remarks
		Gross transactions	PUNC		
A. Completed: Southwestern Engineering Co.	Floration: Various ores in different stages.	$250,000	$250,000	1952 start; completed	Conclusion: Some ores, including the important Aroostock ores, could be preconcentrated to advantage for possible treatment by other processes such as Nossen, Manga Slag, and Sylvester processes.
B. In progress:					
1. Manganese Chemical Co.	Carbamate leaching process for Cuyuna ores and possibly Sylvester concentrates.	3,154,000	1,625,000	Aug. 7, 1952, start; May 1955	Pilot plants of 200 tons per day at Riverton, Minn., should show results soon. Advance of $2,250,000 against procurement of 1,312,000 units of ore for $3,154,000. No provision for loss on advance.
2. Nossen Laboratories, Inc.	Leaching process for Aroostock ores and Government stockpiles of submetallurgical ores.	518,000	518,000	June 30, 1953, start; December 1955	Pilot plant at Paterson, N. J.
3. L. W. King	Leaching process for low-grade manganese, nickel, and cobalt ores	30,000	30,000	September 1954 (start process); June 1955 (extraction); January 1956 (acid process).	Pilot plant at Salem, Ohio, which if successful, will lead to test of acid-manufacturing facilities.
4. Manga Slag, Inc	Pyrometallurgical process slags	2,600,000	195,000	December 1952, start; January 1956	Pilot plant completed May 1954 on basis of advance of $1,320,000. Contemplates production of 13,000 tons 80 percent ferromanganese at loss of $15 ton. No provision for loss of advance.
5. National Academy of Sciences.	Technical guidance	200,000	200,000		
Total		6,752,000	2,818,000		

Mr. ADLERMAN. That shows 6 contracts, 1 which was completed—that is, the Southwest, and the others are the ones mentioned. The total gross funds spent or allocated, have been $6,752,000. The PUNC figures are $2,818,000. Can you tell us what that PUNC figure represents?

Mr. FREDELL. On some of these contracts it was expected that there would be a certain amount of product return on the Manganese Chemical, and also on the Manga Slag. The others, it was not expected that there would be any production as a result of their piloting operations.

Mr. ADLERMAN. In other words, the PUNC figure is really the possible ultimate net cost to the Government?

Mr. FREDELL. Possible ultimate net cost to the Government.

Mr. ADLERMAN. A dead loss?

Mr. FREDELL. That is correct.

Mr. ADLERMAN. When I say "dead loss," I mean dead cost to the Government.

Mr. FREDELL. That is correct.

Mr. ADLERMAN. In some of these research programs you expected some return?

Mr. FREDELL. We expected some return; that did not materialize in the case of Manga Slag.

Mr. ADLERMAN. In Mangaslag you expected a return of quite a substantial amount, but nothing has been forthcoming so far?

Mr. FREDELL. That is correct.

Mr. ADLERMAN. The others have been written off practically 100 percent, except Manganese Chemical where you expect to get at least half back?

Mr. FREDELL. This is correct.

Mr. ADLERMAN. In order to save time and instead of going into each of these individually, suppose we put this into the record.

At the present time, how many of those projects are still in being? How many are being worked on at the present time?

Mr. FREDELL. The Manganese Chemical operation is still underway. Dr. King's pilot plant is nearing completion. Those are the only two that are in being at the present moment.

Mr. ADLERMAN. Are there any others in contemplation right now?

Mr. FREDELL. Yes.

Mr. ADLERMAN. Which ones are in contemplation?

Mr. FREDELL. We have a contract negotiated with the Bruce Williams Laboratories which is practically ready for signature.

Mr. ADLERMAN. Is that the Diamond Alkali?

Mr. FREDELL. Yes.

Mr. ADLERMAN. In association with Diamond Alkali?

Mr. FREDELL. Yes. No, no; that is Sylvester that is associated with Diamond. Bruce Williams is by themselves and Sylvester process was associated with Diamond Alkali.

Mr. ADLERMAN. Both are in contemplation right now?

Mr. FREDELL. That is right. We also have in the works another project to renew the Nossen, the work on the Nossen process.

Mr. ADLERMAN. Are you working on anything at all on the Manga Slag process?

Mr. FREDELL. On the Manga Slag, we have just had that reviewed by an independent group of engineers and we are in the process now

of reviewing their report on it and we have not made any decision as to what will be ultimately done.

Mr. ADLERMAN. How about Dr. King's process? That is in being now, is it not?

Mr. FREDELL. That is in being.

Mr. ADLERMAN. Southwest is complete? You do not expect any further work?

Mr. FREDELL. We do not expect to do any further work on that phase of work that Southwestern was contracted for.

Mr. ADLERMAN. Mangaslag, and Nossen, are both being reviewed for possible continuation and you are contemplating entering into contract with Bruce Williams and Sylvester, is that correct?

Mr. FREDELL. That is correct.

Mr. ADLERMAN. Are there any others in contemplation besides that?

Mr. FREDELL. None that are anywhere near that stage. There have been various other proposals submitted at various times, some of which have lacked technical feasibility. Others have had insufficient basic research done to justify our going in to work on them. In that connection, I would like to explain that our place in this research picture, being a defense agency, we were charged with increasing the production and our aim was not particularly to develop, to set up research establishments for the development of new processes, basic research, but rather to take processes which had gone through a stage of basic research and take them into the pilot plant stage and get them into production and see if they could be brought into production immediately. Our object was to get production as fast as possible in order to satisfy stockpile needs and defense needs.

Mr. ADLERMAN. In other words, you really had a limited objective there, is that correct? You did not want to encourage anything new, any experimental work that had not already shown promise?

Mr. FREDELL. We are perfectly willing to encourage it, but we do not feel that it was within our province to start a research group and tell them, "Here is some manganese, see what you can do about getting a new process," because that type of work is a long-drawn-out process. Our agency was primarily a defense agency created for the purpose of getting manganese and getting it quickly.

Mr. ADLERMAN. Perhaps that might be one of the things you might accomplish with such type of research.

Mr. FREDELL. That might well be.

Mr. ADLERMAN. You might need a fresh outlook.

Mr. FREDELL. That might well be. We felt that there was a sufficient number of processes which had gone through laboratory stage that were not being piloted, that were being kept in the laboratory stage.

Mr. ADLERMAN. Do you not think that a more dynamic approach is necessary?

Mr. FREDELL. We think that that type of research should be confined to what might be termed the old-line agencies who are continuing agencies. Their efforts had best be devoted to development of new processes. When processes show some signs of life they should be taken out of the hands of those people, the research people, and put in the hands of operators, because at that stage it ceases to become a strictly scientific research problem, but rather an engineering research problem. The development of a process to a pilot plant stage, or to a

production stage, is not fundamentally the realm of a research metallurgist, but should be in the hands of operating people.

Mr. ADLERMAN. How much money do you have left now for research?

Mr. FREDELL. I believe it is in the neighborhood of $2 million.

Mr. ADLERMAN. You say you have about $2 million?

Mr. FREDELL. About $2 million of uncommitted funds.

Mr. ADLERMAN. At the rate you are going, it would not seem that you would be utilizing that unless you start some new projects?

Mr. FREDELL. The things that we have in the mill at the present time will just about use up the amount of money that we have. We have just about enough money to take care of the projects.

Mr. ADLERMAN. The King project and the Manganese Chemical have already been allocated?

Mr. FREDELL. That is correct.

Mr. ADLERMAN. The Manga Slag and the Nossen processes, how much will they require?

Mr. FREDELL. The Manga Slag we do not know how much that will require.

Mr. ADLERMAN. How about the Nossen, what do you contemplate on that?

Mr. FREDELL. The Nossen will probably be in the neighborhood of, well, $240,000 is the latest we have on that.

Mr. ADLERMAN. On the two projects, Bruce Williams and Sylvester?

Mr. FREDELL. Bruce Williams will be just under $200,000 and the Sylvester process will be in the neighborhood of half a million dollars.

Mr. ADLERMAN. All in all, then, you have $900,000 allocated to these other projects and you still have $1,100,000 over?

Mr. FREDELL. That is correct.

Mr. ADLERMAN. So you are not contemplating using that $1.1 million now?

Mr. FREDELL. We do not have a definite spot for it right at this moment. We will very likely have some place to use it in advancing or elaborating some of these other projects which are now in being.

Mr. ADLERMAN. In the conduct of these research jobs, how much supervision do you exercise over them?

Mr. FREDELL. Our own engineers make trips to see these projects as they develop. We call on the Bureau of Mines though our agreement that we have with the Bureau of Mines, call on their field teams to inspect them and we have had the National Academy inspect, monitor, and report on some of them, and we have also had independent metallurgists.

Mr. ADLERMAN. Do you have resident engineers assigned to these jobs?

Mr. FREDELL. We have not had any resident engineer on any of these.

Mr. ADLERMAN. Do you not think it might be worthwhile to have a resident engineer on the bigger jobs?

Mr. FREDELL. On the bigger jobs, I think it is. In keeping with that, our recent jobs on titanium, we do have resident engineers. For some long time we were limited in our number of people we could have on our payroll and we did not have any resident engineers out at that time. Also, we were limited in getting men for that type of work, competent men.

Mr. ADLERMAN. You feel that the salaries that are offered are too low?

Mr. FREDELL. Definitely.

Mr. ADLERMAN. Has the GSA, or as far as you know, have they made any representations to Congress for relief from the civil-service rules on engineers and technicians of this type?

Mr. FREDELL. I do not know that they have made any official representation on that.

Mr. ADLERMAN. Do you think that they might contemplate such representation, formal requests, that they be given relief along those lines?

Mr. FREDELL. I think it would be a great relief if they would.

Mr. ADLERMAN. Would you suggest that?

Mr. FREDELL. I would be glad to.

Mr. ADLERMAN. How much more money do you think will be necessary to carry on a well-developed, well-thought-out program for research to lick the whole problem? Have there been any estimates made in GSA for that purpose?

Mr. FREDELL. That would be going down to figuring out how much you would have to spend on basic research as well as——

Mr. ADLERMAN. You have to have some plan of action?

Mr. FREDELL. That is right.

Mr. ADLERMAN. You must have some idea where you are going, you must have some idea what you have to spend. Have you sat down and thought this thing out, how much would be required for such a program? Of course, I know you cannot be exact on your dollar-and-cents figures, but you should have some overall figures to shoot at.

Mr. FREDELL. I would think that there would be room to spend $2 or $3 million a year for 5 or 6 years.

Mr. ADLERMAN. That would mean a continuing program rather than a year-to-year program?

Mr. FREDELL. Definitely a continuing program, because you cannot do research on a year-to-year basis, because so much of it is long range.

Senator MALONE. The emergency procurement services make contracts for purchase of certain materials, do you not, in your organization, or the GSA?

Mr. FREDELL. Yes.

Senator MALONE. What materials do you cover?

Mr. FREDELL. We cover all the strategic materials in the stockpile.

Senator MALONE. This table on manganese has been made a part of the record?

Mr. ADLERMAN. Yes, sir.

Senator MALONE. There were indications yesterday, or the day before yesterday, in the testimony of Dr. Flemming that the Wenden depot would not close down April 30, it would be extended to, I think, May 30?

Mr. BROADGATE. Yes.

Senator MALONE. Was there any indication that they could enlarge or extend the amount that could be accepted at that depot, only extend the time until the amount originally allocated was furnished?

Mr. ADLERMAN. According to that, Dr. Flemming stated that in view of the fact that the depot had not been filled to the obligation that they were supposed to be filed, they would extend it to May 30.

Now we have found out that they are not contemplating extending it. I think Mr. Broadgate here has more definite information on that.

Senator MALONE. If you had some assurance that there was a continuing program sufficient to investigate the slag situation, what is your opinion on the situation we might find ourselves in at the end of a four or five year period with regard to self-sufficiency and production in an emergency in this country?

Mr. FREDELL. I think that we could develop processes that would produce sufficient manganese to hold us through an emergency if we had a long-range research program that was continuous and I think that we could develop sufficient processes that would enable us to recover manganese from the slags and from the low-grade ores in sufficient quantity to satisfy emergency requirements.

RECOVERY OF MANGANESE FROM SLAG

Senator MALONE. Speaking of the slag, yesterday it was estimated that about 60 percent of the annual requirements of manganese could be supplied from that source alone. Have you come to any conclusion in that regard?

Mr. FREDELL. There is that amount of manganese available in those slags. Your question is building sufficient facilities to treat that amount of material together with the ancillary facilities needed for coke and so forth to treat it.

Senator MALONE. All that would not be a great problem providing the process is worked out so that it was a profitable venture or a feasible venture as far as stockpiling is concerned, would it? It would be just a question in peacetime of money to do it?

Mr. FREDELL. I think that is the entire question. There are two things, as far as developing processes for obtaining the material, I do not think there is any doubt but what we can do that. As far as developing a process that will obtain the material and produce it at a cost that would be competitive with world manganese costs, I have very grave doubts.

Senator MALONE. Is there anything in the United States that we can produce in competition with the world if they have our machinery and our foremen?

Mr. FREDELL. There are a lot of things that we are competing on in the world market today.

Senator MALONE. What are they?

Mr. FREDELL. Electrical equipment.

Senator MALONE. They tell me that they are in grave danger because our American people take our own machinery, our own foremen, and superintendents and go there and build these factories that are the best because they are the latest and then work the low-cost labor. There is not any use talking about competing with the world, you cannot do that. But, can you get it at a price in this country, considering the additional cost would not be any more than the wages and taxes and cost of doing business here as compared to the foreign nations?

Mr. FREDELL. That is the question. When you talk about getting it down to a price that is supportable.

Senator MALONE. Well, the testimony yesterday showed that it might cost around $3 a unit and with the byproducts it would cut that in half. Do you agree with that estimate?

Mr. FREDELL. From what I have seen of processes so far, it looks like the price would be in the neighborhood of something between $2 and $3 a unit.

Senator MALONE. Would that consider the byproduct, or is that the cost itself?

Mr. FREDELL. I think that too much theoretical consideration has been given to byproducts. I doubt very much if the byproducts will approach the theoretical figures that have been assessed to them in most of these cases.

Senator MALONE. What would you say? Where should the cost land, not considering byproducts?

Mr. FREDELL. Somewhere between $2 and $3, depending on the processes.

Senator MALONE. What would you say, then, relative to the byproducts? Would you give them any consideration at all?

Mr. FREDELL. Yes; I think they would have to be given consideration.

Senator MALONE. To what extent, conservatively?

Mr. FREDELL. All processes do not produce a salable byproduct, neither do all ores lend themselves to producing a salable byproduct. There are certain types that do and certain types that do not. For instance, in the slags, I think the slags are going to be a high cost, in the very highest cost as well as probably the silicate ores, the more difficult ores to treat, and will probably be the higher-cost ores.

Senator MALONE. We are talking about the slags now. If you worked out the process, worked the slags, do you think it would come to someplace between $2 and $3?

Mr. FREDELL. I believe it would be in that neighborhood.

Senator MALONE. What would be your estimate that the byproduct might carry of it, the percentage of it?

Mr. FREDELL. Well, I think you are including your byproducts and, on that basis, we would do well to get the ultimate cost down to $2 on the slags.

Senator MALONE. The price we are paying now is $2.30, the special price guaranteed now?

Mr. FREDELL. That is correct.

Senator MALONE. If you got it down to $2.30, do you think that would be a conservative estimate that it could be done in a reasonable time?

Mr. FREDELL. There is a possibility they can reach that point; yes.

Senator MALONE. Considering the byproduct from what you have just said, would that be a conservative estimate? You said we would be lucky to get down to $2. I do not think you need to get to $2, but down to $2.30 or $2.50. I do not say you ought to, that is your business, but I say to make it competitive on the basis that I just outlined.

Mr. FREDELL. It would have to get down to that price.

Senator MALONE. Do you think it could?

Mr. FREDELL. I think it probably could.

Senator MALONE. In your opinion, would ODM buy it at that price for stockpile?

Mr. FREDELL. Would ODM buy it at that price for stockpile?

Senator MALONE. If it were necessary for the stockpile.

Mr. FREDELL. I could not speak for ODM. I do not know what their policy would be. It is supposed to be that they are not to pay over the market price unless they cannot obtain it.

Senator MALONE. You are talking about world prices?

Mr. FREDELL. That is correct.

Mr. BROADGATE. Mr. Flemming testified, Senator, the other day, that in order to obtain manganese domestically or otherwise in other places, "But it must also be based on a finding that the material cannot be obtained more advantageously elsewhere."

Senator MALONE. Yes. I think there is a very grave difference of opinion in the Government at this time on the basis of domestic industry. Some of us believe you ought to have a principle of protection, thatt he duty set forth in the Constitution of the United States in section 8, article 1, where it says the Congress of the United States will regulate foreign trade and the domestic economy that that principle would be a basis of fair and reasonable competition in any product, then that basic protection would be that differential cost. That is not the policy of the Government at the present time. The policy of the Government at the present time is under the 1934 Trade Agreements Act. If we extend it for another 3 years with a 15 percent reduction in the duty, there is not any question in my mind what you are going to do with most of these materials. You are going to continue to buy them from foreign countries until war breaks out and then you cannot get them. That is one way of whipping the United States of America. My own idea is that we ought to have a going concern, industry, based on a principle of protection for the American investors and workmen and then you will get some private money in these businesses. If it is profitable, they will produce this manganese.

Right now manganese production in several Western States is closing down. Zinc and lead has closed down. We are talking about a principle, but the reason I wanted to get your idea is because you are an expert in this business.

If this slag is available and the cost can be worked down close to the $2.30 that we are guaranteeing now, I think that is very close, or even below what the principle of protection would be if Congress reverts to it.

Mr. FREDELL. There is a possibility of getting down toward that price, yes.

CUYUNA RANGE RESEARCH PROJECT

Senator MALONE. Now, the Cuyuna Range is another great possibility. Do you think the price might land there under a situation such as we have outlined here, continuity of research?

Mr. FREDELL. They just started their production there in their pilot plant and I do not have any figures on their cost at present, but I imagine that they will probably be down close to the $2 mark also, $2.30.

Senator MALONE. Could now, or would it take more research to do that?

Mr. FREDELL. I think that when they complete their pilot work they are now doing.

Senator MALONE. They can get down to close to $2?

Mr. FREDELL. I think they will probably approach it.

Senator MALONE. That they can make a profit on it at $2?

Mr. FREDELL. There will not be very much profit in it at that price, no.

Senator MALONE. But at $2.30 or $2.25, or something under $2.30 they will produce at a profit?

Mr. FREDELL. I think so.

Senator MALONE. Testimony yesterday seemed to support the conclusion that on a long-term 10 or 15 years' guarantee of price, in order for private investment to be made and amortized on a principle of protection such as I have already outlined, that you might get on a going-concern basis in the production of manganese in this country from one-third to 50- to 60-percent of the annual consumption.

Mr. FREDELL. On that basis, if you got to 50 percent of annual consumption, assuming the annual consumption is approximately 2 million tons a year.

Senator MALONE. 46 percent?

Mr. FREDELL. 48 percent.

Senator MALONE. 48 percent.

Mr. FREDELL. That would mean that we would have to produce 1 million tons of 48-percent material and that would be 48 million units to be produced at a price—suppose that they reach the $2.30, that would be $1.50 above the world price.

Senator MALONE. I am not worrying about the world price. You are always going to get anything you name cheaper someplace else outside the United States where they pay cheaper wages. I am not worrying about that, I am worrying about the United States of America. What do you think of the amount?

Mr. FREDELL. This would be at a price of $1.50 above the world price, would be something like $70 million a year that it would cost us to maintain an industry at that level.

Senator MALONE. I am not worrying about $70 million as long as we are putting out $5 billion and giving it bodily to foreign nations. Let us not worry about that. Let us worry about production, whether it is manganese or chromite or textiles, at a price that will not be too much above that differential between the cost of doing business in the chief competitive nation and in this country on each product. Let us see what that comes to; that will be the business of the Tariff Commission if we can get it back in business.

Now we have been worrying here for 22 years about the price where they pay 50 cents a day for labor in the foreign country and we pay more than that per hour and we talk about competing. You should know, you are as old as I, that you cannot do that. You are going to talk about foreign production or a guaranteed price. Let us forget that a moment and answer these questions on this basis.

With the estimate of low-grade manganese ore in this country, and we are producing, we will say 50 percent, and let us assume we can get down to this price of around $2.30 that you have already testified you think you can, what is the outlook, how many years ahead of us? You have made some estimate of the amount of these ores?

Mr. FREDELL. These various projects underway now, they look as though some of them will be completed in the next year or year and a half. Some of them will probably take longer.

Senator MALONE. Regardless of that time, what is the supply ahead?

Mr. FREDELL. In 5 or 6 years there will be a process developed for this.

Senator MALONE. All right. Then what is your estimate of the tonnage in the Cuyuna Range, Maine, how long would it last? What is the possibility? Do you not have in mind just some overall tonnage in the Cuyuna Range? Did they not say it was about 300 or 400 million tons yesterday?

Mr. FREDELL. Yes, I have a table here that shows some estimates. This is an estimate that was prepared by the National Academy of Sciences. In the Cuyuna this estimate shows the various types of ore they have up there, some 675 million tons.

Senator MALONE. Someone else suggested there might be 3 to 4 billion tons. Did you ever hear a figure of that kind mentioned?

Mr. FREDELL. I heard it here day before yesterday.

Senator MALONE. But you do not know anything about that?

Mr. FREDELL. I do not know the reserves myself.

Senator MALONE. Another thing that was mentioned here yesterday was when you establish one of these depots and set a grade of ore within the limits, reasonable limits, that you find there are many deposits of manganese that you otherwise know nothing about. Does that happen?

Mr. FREDELL. That happens when you are developing.

Senator MALONE. One of the things that is happening in Washington is that they add up what they get from the companies operating as to their reserves and they say that is all there is of that particular material and when we mine that we are out of it. They said that before World War I. After every war, no matter how much you use, you always have more reserves than you had when you started. You have more now than you ever had in the world. Is not the history of all these materials, including petroleum, that when it is a profitable thing you continue to discover more reserves than you mine?

Mr. FREDELL. That is right; exploration always brings it in.

Senator MALONE. Is not the tipoff a profitable operation on a principle or a long-range deal?

Mr. FREDELL. Certainly a profitable operation induces more exploration.

Senator MALONE. The national policy for the last 22 years works against that principle. There is a hammer hanging over the head of every businessman in America. He can wake up in the morning and his protection is reduced and he is out of business. So the principles we adopt here work against what we hope to attain, and that is more material. What we are trying to determine here is how soon the process on manganese can be worked out. You agree that in 4 or 5 years you would be in a position to build some plants?

Mr. FREDELL. I would think that at the rate research is going they probably would have results in that time.

Senator MALONE. And you believe then, with proper incentive, that the annual production on a going-concern basis, that you might produce between 33⅓ and, say, 50 percent of the annual consumption in this country?

Mr. FREDELL. Sure, the tonnage is certainly there to be produced if the incentive were sufficient to cause them to produce that at a profit, and they would certainly produce it.

Senator MALONE. You think it might be done under the $2.30 that we talked about per unit?

Mr. FREDELL. Indications are that they will approach that $2.30 price.

Senator MALONE. Then there might be all the manganese that we would need in the foreseeable future if such a program were worked out and a principle arrived at so that private investors could invest their money and amortize their investment and see a profit? Do you think that is a possibility?

Mr. FREDELL. Yes; under those conditions.

Senator MALONE. Would you favor this set of conditions being established?

Mr. FREDELL. To a certain degree, Senator. It all depends on just how much—I am certainly in favor of maintaining our present American standard of living. How much we can afford to expand, for instance, this particular industry that we are talking about now, how much we can subsidize it in one way or the other, either by guaranteed price or by tariffs, however it is done, if it is called a subsidy of a price arrangement that is set up, as to how big an industry we can afford to expand to, that is a little bit beyond my estimation. I do not know all the economics of the country far enough to do that.

Senator MALONE. If you are in favor of maintaining the standard of living here, would you be in favor of either setting a guaranteed price for a long enough time so that private investors could afford to invest their money or establish a principle of protection that would pay the difference between the wage standard of living here and the taxes and the general cost of doing business as contrasted with the chief competitive nation on, say, this one material, manganese? Or do you think that we should buy it wherever we can get it the cheapest regardless of the wages and follow that principle on every commodity?

Mr. FREDELL. I think that we have, during the last war, World War II and in Korea, we have established a domestic manganese industry on a small scale. A lot of people have gone into that and put their money into it, are working in it.

Senator MALONE. And lost it.

Mr. FREDELL. Some of them have lost it and some are still struggling. So that a certain number of people are already involved in that industry and are entitled to continued protection. They have gone into this thing in good faith to help the Government out in time of stress. I think this program should be continued for a long enough time certainly to bail them out and keep them going so that they will not be hurt. I do not know that we are justified in expanding that industry—that is, creating a larger industry in that respect knowing that it is going to have to be paid for by other segments of industry; that all the rest of the people are going to have to pay for it one way or the other, and they themselves, whether we should expand that industry which requires assistance now; that, I am not entirely clear on.

Senator MALONE. You understood what I was trying to say, that if you expanded it beyond the difference in the wage and taxes and

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cost of doing business, that would be a subsidy. I do not call it a subsidy. I call it maintaining our standard of living.

Your testimony, in my opinion, is good on the possibilities of producing one-third to one-half of the manganese in this country in the foreseeable future. Could it be done in the foreseeable future?

Mr. FREDELL. Yes, if conditions for the industry to survive were established, why, certainly it could be done.

Mr. FREDELL. Yes, if conditions for the industry to survive were established, why, certainly it could be done.

Senator MALONE. It seems to me we try to lose a war. We are getting approximately 900,000 tons annually from India, and you could not get a pound of it hours after a war starts. So if I were a resident of Russia and trying to get us whipped, I would discourage production in this country.

So the purpose of this thing, as far as I am concerned, is to determine what can be done here: first, for the preservation of this country on defense, and next to preserve the economic structure.

Mr. FREDELL. Well, in my opinion, the first thing that should be done, the most important thing that should be done at this time, is to have an intensified research program on manganese.

Senator MALONE. That is what we had you here for.

Mr. FREDELL. I am all in favor of that and I think it should be pushed and I have some ideas how I think it should be organized. I think it should be well organized when it is started.

Senator MALONE. Do you have some questions, Mr. Broadgate?

Mr. BROADGATE. Yes, sir.

LAST OF DOMESTIC MANGANESE

The testimony heretofore given on the research and development programs would indicate that there is no cost at the present time established, even theoretically, much below $2, is that not true?

Mr. FREDELL. I think that is a pretty general rule.

Mr. BROADGATE. According to Mr. Fleming's principle, which has been announced by the Government a number of times, that under the domestic manganese program, aside from that established by law which expires June 30, 1958, all manganese must be obtained at terms most favorable to the Government or, in other words, at market prices. There is not any one of these processes as far as I can judge from the testimony that is within shooting distance of an ordinary market price for manganese, is that true?

Mr. FREDELL. That is the testimony that has been given; that is what we have seen.

Mr. BROADGATE. So that no consumer could use that product and the Government would not buy it. Is that not, in effect, the situation?

Mr. FREDELL. Approximately.

Mr. BROADGATE. Then what are we shooting at? It is nice to have the processes and I think they should be worked up to expand the mobilization base—and I think you gentlemen are doing a good job in that direction—but is anybody, including the Government, going to put in any full-scale plants to actually work these problems out on a production scale if there is nothing to do with the manganese?

Mr. FREDELL. I think that right there is a point that probably should be brought out a little bit. You asked what are we shooting

at? My understanding of what we are shooting at is to prepare ourselves for an emergency. If that emergency comes along and we cannot get offshore manganese, we are going to have to have manganese. So what we should be preparing ourselves for is to be able to supply ourselves with manganese by some means or other, regardless of the cost at that particular time, because at that time cost is not as important as in ordinary peacetime.

Mr. BROADGATE. Mr. Fredell, we are perfectly in agreement on that.

Mr. FREDELL. We do have a stockpile built up and we have to augment that stockpile; and that is what we should be shooting at.

Mr. BROADGATE. We are in perfect agreement on that, but nevertheless, apparently to put these processes into practical operation on the vast scale that might be required would take several years, even though pilot plant work is done?

Mr. FREDELL. If the pilot plant work was done and the process is proven and engineering design is prepared, the question of building the plants would be a matter at the outside of 2 years time to build a plant.

Mr. BROADGATE. It does remain, however, that there is no outlet for the manganese at the present time and it would only be under forced draft of war and war prices that those production plants could be built and be put into operation.

Mr. FREDELL. That is right. That is when they should be put into operation.

WENDEN DEPOT

Mr. BROADGATE. All right, sir. There is one other thing I would like to go into before I go into the Butte-Philipsburg situation. As I understand it, the Wenden quota will be actually exhausted at the end of this month?

Mr. FREDELL. I think that from the figures we had yesterday it looks like some time during this month.

Mr. BROADGATE. And the closing order as of April 30 will not be rescinded and extended to May 31, as Dr. Flemming indicated?

Mr. FREDELL. No, I do not think it will, because the order is to close when we get 6 million units and I do not think they are going to cut it off at exactly 6 million units. There may be a few units one way or the other, possibly a little over.

Mr. BROADGATE. But as Dr. Flemming has indicated, he will not, or cannot, assign more units to Wenden; then it is inevitable that it close at the end of this month?

Mr. FREDELL. Apparently that is the situation.

Mr. BROADGATE. There is one other point I would like to bring up about that. You may not be competent to answer, and I do not want to put you in a corner. Dr. Flemming said:

> Under the act that we work under, the use of the funds that the Congress has made available must be based on findings that the material is needed for defense. Of course, there is no difficulty there, but it must also be based on a finding that—

he means manganese there—

> it cannot be obtained more advantageously elsewhere.

Now, is it not true that if Dr. Flemming made the determination that there was urgent need for domestic manganese, that under the Defense Production Act, he could pay over-market prices?

Mr. FREDELL. Yes.

Mr. BROADGATE. This is a very inconsistent statement?

Mr. FREDELL. Yes, he could. But it all depends on the timing of when you do these things. At the time this was originally started, and they did set up some of these over-market prices, I do not believe the stockpile situation was at all comfortable and that would make quite a difference in what they would pay.

Mr. BROADGATE. I realize that, Mr. Fredell.

Mr. FREDELL. You know in the case of nickel——

Mr. ALDERMAN. Would you say the stockpile today is in comfortable shape?

Mr. FREDELL. At the time we made that decision the stockpile was not in comfortable shape.

Mr. ADLERMAN. Would you say it is in comfortable shape now?

Mr. FREDELL. It is in a better shape.

Mr. ALDERMAN. But not in a comfortable shape.

Mr. FREDELL. It all depends on how many years' supply, how much of an emergency.

Mr. ADLERMAN. There has not been a great change since the time the Defense Production Act went in and the present time?

Mr. FREDELL. Yes, there has been a considerable change between material that has already been received for the stockpile and contracted for the stockpile.

Mr. ADLERMAN. I know it has been contracted for, but has it been received?

Mr. FREDELL. There have been certain receipts, yes.

Mr. BROADGATE. The reason I raised this issue, Mr. Fredell, is because these programs were started under the Defense Production Act when, as you say, there was perhaps more of an emergency and the stockpile was not in as good shape as it is now, whatever shape it is in now. But, Dr. Flemming said when asked about declaring the material needed for defense, "Of course there is no difficulty there." In other words, my assumption is that Dr. Flemming could and the conditions would warrant his declaring the material being needed for defense. That being the case, and he admits he can make that determination, he is not making the determination. If he did make the determination, he could pay over-market prices and add new units to the Wenden depot. This is very inconsistent. I realize we should have ODM before us.

Mr. FREDELL. It evidently depends on what the policymakers feel, whether it is necessary or not.

Mr. BROADGATE. He says it is an easy thing to do. In other words, he could go back to his office and pick up the telephone and have a directive written to do it, he admits it here.

Mr. FREDELL. I do not know what manner their policies are arrived at. We act on the policies they set for us.

Mr. BROADGATE. That is something I wanted to go into before I complete this line of questioning. It is my understanding that the GSA and its dependent agencies are purely service agencies and are subject entirely to the directive of ODM?

Mr. FREDELL. That is correct, we are.

Mr. BROADGATE. You cannot get any money, you cannot establish a project?

Mr. FREDELL. That is correct.

Mr. BROADGATE. Unless ODM issues a directive?

Mr. FREDELL. That is correct.

Mr. BROADGATE. Within that framework, how autonomous is your action? How far can you move between these borderlines?

Mr. FREDELL. The normal process is that the ODM establishes the requirement and that figure is given to us and we work up a program for fulfilling that requirement, projects that we have in mind, or projects that we contemplate would supply that requirement.

Mr. BROADGATE. You just work out the technical and economic basis, then? They issue an overall directive?

Mr. FREDELL. As to how many tons of manganese they want, for instance.

Mr. BROADGATE. Yes; and you get it as best you can within their framework?

Mr. FREDELL. We work it up and submit our program to them, the different types of operations that we plan, how we plan to obtain it and where we plan to obtain it and that is approved by the ODM Borrowing Authority Review Board. When that is approved they apportion funds for that project. In the past we were then allowed to go ahead and work and make modifications to our program. As we went along, one project would fizzle out and we would replace it with another one, or something better would come in and we would take advantage of that. Recently we had to take each project as we come to the contracting stage and ready to finalize it, we have had to submit it to ODM for an approval on an individual project basis; that is the situation we are working under at present.

Mr. BROADGATE. Thank you, Mr. Fredell.

Chairman Murray is, of course, very much interested in promoting the cause of domestic manganese, and I think perhaps he would go a little further than the Government in helping to expand the mobilization base, as the newest neat tagline has it. He is also interested in these research and development programs.

BUTTE-PHILIPSBURG DEPOT

At Butte-Philipsburg there is a unique situation, because there we not only have a plant built adjacent to the stockpiles, but we also have two classes of ore involved. Am I right, Mr. Fredell, that that is the only station that buys both black and carbonate ores?

Mr. FREDELL. That is right.

Mr. BROADGATE. Can you give me off-hand—I know it is in the tables—the tonnage of black ore at the present time, or Butte-Philipsburg in combination?

Mr. FREDELL. Well, as of the end of December the oxide ore was close to 40,000 tons.

Mr. BROADGATE. What is the intake?

Mr. FREDELL. The intake so far this year, I think, has been in the neighborhood of around 4,000 tons a month, I believe. I think they have had about 6,000 tons all together of which 2,000 was carbonate ore and 4,000 oxide ore.

Mr. BROADGATE. Do you expect that the station will operate on that intake until June 30, 1958; that is, the combined oxide and carbonate intake? I have not gone to the carbonate yet.

Mr. FREDELL. I rather think they will hold pretty close to that. I think there are enough properties around there to satisfy that.

Mr. BROADGATE. You do not think they will close down before the closing date as Wenden has?

Mr. FREDELL. No, I believe that the Butte figure showed that they will probably last out, table 6, through fiscal 1958.

Mr. BROADGATE. Very well. How much money does the Government have invested in the mill at Butte?

Mr. FREDELL. I do not know that figure as to how much they have in the mill.

Mr. ADLERMAN. Does anybody else know that?

Mr. FLEMMING. I believe it is of the order of $350,000.

Mr. BROADGATE. Will you supply the exact figure for the record?

Mr. ERICKSON. We will supply that figure. The question is, how much money does the Government have invested in the mill at Butte?

Mr. BROADGATE. The entire plant at Butte, not what it has expended in service charges, and that sort of thing, but the actual capital investment there.

There is no pilot plant at Butte, I understand?

Mr. FREDELL. The Government does not have a pilot plant, but I understand there is a small pilot plant erected on the premises there. I do not know whether it is owned by a domestic manganese company, or whether it is owned by another individual.

Mr. BROADGATE. We can determine that later, but there is a pilot plant there?

Mr. FREDELL. There is a small pilot plant there.

Mr. BROADGATE. Is it large enough, do you think, to be adequate for any test work that should be done on these ores on a pilot plant scale prior to putting the main plant into operation?

Mr. FREDELL. What is the capacity of that? I believe it is about one ton a day. I would think that would be large enough for the work on beneficiation, yes.

Mr. BROADGATE. That could be used for pilot plant work on either the carbonate or oxide ores?

Mr. FREDELL. I imagine that they could switch their flow sheet around to use either one. That is a flotation plant, you understand.

Mr. BROADGATE. Yes. You already have a pilot plant there that if it needs any remodeling the cost would be pretty small probably and you already have a mill. The mill, I presume, has been lying idle for a long time and might need some work done on it?

Mr. FREDELL. I understand it would be about $175,000 to rehabilitate that mill.

Mr. BROADGATE. Why so much?

Mr. FREDELL. Well, I believe they are going to have to change the flow sheet around quite a bit and there would be quite a bit of reconstruction in it from the previous operations.

Mr. BROADGATE. I see. The storage facilities for manganese ores are adjacent to the plant, are they not?

Mr. FREDELL. They are.

Mr. BROADGATE. As the ore comes in it is being segregated per shipper?

Mr. FREDELL. I understand that is the way they are piling it there. Each shipper has his own pile.

Mr. BROADGATE. Is there any intention of mixing those ores?

Mr. FREDELL. Not an immediate intention, but I would imagine that when they start operation there that they—there are some variations of the ores and I doubt whether the mill could operate switching from one flow sheet to another, but they would probably have to develop a flow sheet for maybe 2 or 3 different types, and maybe be able to consolidate those number of piles into possibly 2 or 3 different types of comparatively similar ores.

Mr. BROADGATE. As a practical matter?

Mr. FREDELL. As a practical matter for mill operation.

Mr. BROADGATE. There is, however, a considerable variation in recovery from the various mines?

Mr. FREDELL. That is right.

Mr. BROADGATE. It would not be wise then to just throw everything into one pile?

Mr. FREDELL. No.

Mr. BROADGATE. It is my understanding from the Domestic Manganese & Development Co. that if stockpiling there is continued without milling, without beneficiation, additional ground will be required if these piles are to be kept segregated, is that true?

Mr. FREDELL. I expect it probably is.

Mr. BROADGATE. Is the Government prepared to expand its storage facilities?

Mr. FREDELL. I suppose if necessary to do so, they will have to do so.

Mr. BROADGATE. They prefer to do that rather than start the mill?

Mr. FREDELL. Well, I do not think the mill is ready to be started at present because if they started the mill at the moment they would start up on the same flow sheet that they used in previous operaions.

Mr. BROADGATE. With this $175,000 spent on it?

Mr. FREDELL. They could not spend $175,000 until they had done more test work to see if they could not get a better flow sheet than they had previously.

Mr. BROADGATE. Yes, of course we have a pilot plant there in which this work would be done?

Mr. FREDELL. That is correct, but that work should be done before any thought is given to starting that mill again because it would be just folly to start and run at the recoveries they obtained previously, it would not be good engineering.

Mr. BROADGATE. Why is not the Government running that pilot plant or giving a contract to someone like Mr. Griswold to run that pilot plant and find out about this flow sheet instead of having perhaps to do it under emergency conditions?

Mr. FREDELL. We have a proposal in at the present time to do some pilot work on the oxide ores in that pilot plant.

Mr. BROADGATE. Who has to approve that?

Mr. FREDELL. That is in our office at the present time. We have gone over it and we have now submitted it to the Bureau of Mines. You heard the testimony of the Bureau of the Budget. Any research work that we do has to have the blessing of the National Academy of Sciences and the Bureau of Mines as well as our own technicians.

Mr. BROADGATE. That is a lot of mechanisms for a 1-ton plant to go through.

Mr. FREDELL. It is, but that is the situation that prevails. We cannot go out and make a contract with these people to do that until we go through this exercise and find out whether the Bureau of Mines has the money to do it with their own funds, whether they have the facilities to do it and whether they have the people to do it, and when they could do it.

Mr. BROADGATE. It seems to me that the GSA should have a little more automony than that when it comes to this sort of thing. A 1-ton plant, probably it would not cost very much to put it in shape and you have to go through the same routine as though it were a million-dollar property.

Mr. FREDELL. Exactly. In fact, there is probably more work involved.

Mr. BROADGATE. Do you think that is silly?

Mr. FREDELL. I think it is more than silly.

Mr. BROADGATE. I am glad you agree with me. Presuming that pilot plant work had been done on the black ores and found to be satisfactory, do you think there would be any chance of immediately thereafter rehabilitating the mill and putting it into operation?

Mr. FREDELL. To do that, we would have to go to ODM and get their approval and get finances to carry on that operation.

Mr. BROADGATE. I realize that. It is the same routine you just mentioned, but do you think there would be any chance of getting such an approval?

Mr. FREDELL. Oh, there is always a chance that they will change their minds, but from what Dr. Flemming testified yesterday, we would be obtaining manganese and we would know that the cost would be above world-market price, so if he followed that line they would not give us the money to do the job.

Mr. BROADGATE. But, of course, you have the money to do the job. You have collected the money from the miners?

Mr. FREDELL. But they would not release it.

Mr. BROADGATE. You do not have the money?

Mr. FREDELL. We do not have the money.

Mr. BROADGATE. I often wondered who had that money.

Mr. FREDELL. The money is there, the money has been appropriated for that particular purpose, but in order to get it, it has to be allocated.

Mr. BROADGATE. Appropriated, sir? It has been deducted from the miner's shipments.

Mr. FREDELL. That is correct. It has been set up in a fund at the time the miners' shipments are made. It is not deducted from the miners' shipments. The miners are paid an amount which together with the upgrading costs would equal the $2.30; that is the contracted price with the miners.

Mr. BROADGATE. But there is a flat deduction of $16.60 per ton less freight, is there not?

Mr. FREDELL. From the calculated price at $2.30. In other words, the Government figures that the total cost of that is going to be $2.30 and they deduct $16.60 from the calculated recoverable value in the ore. The balance is paid to the miner and the $16.60 is supposedly set up in a reserve fund for upgrading those ores.

Mr. BROADGATE. Are you going to give it back to them?

Mr. FREDELL. No, there is no reason why we should give it back to the miners because the miners do not upgrade it. The miners are

being paid for an upgraded ore at a price which is $16.60 less than the $2.30 unit price would give them.

Mr. BROADGATE. Supposing it cost less than the $16.60, would there be a rebate to the miners?

Mr. FREDELL. I doubt that.

Mr. BROADGATE. I doubt it too, but it seems to me only equitable that they should get it back.

Mr. FREDELL. I also doubt that the $16.60 is what it will cost.

Mr. BROADGATE. I was about to ask you that. I want to know first how much money you have collected.

Mr. FREDELL. I do not know. I do not have that figure.

Mr. BROADGATE. Will you supply it for the record?

Mr. ERICKSON. We have not collected any money from miners.

Mr. BROADGATE. How much is in the trust fund? How much is set up?

Mr. ERICKSON. In other words, the question is, What would the difference be between the payment at the $2.30 per unit price for 48-percent manganese, the difference between that price and the price that we have actually paid for the approximately 24-percent manganese that we have received which would be about $1.30 or $1.40, in that range?

Mr. FREDELL. That is the difference.

Mr. BROADGATE. Is it not actually the $16.60 per ton deduction less freight or perhaps $4, so that really you should have a reserve fund of around $12-odd a ton, which everybody has presumed was being held in trust for these various stations to put up a plant to beneficiate the ores. Otherwise, why the deduction?

Mr. ERICKSON. You are putting it in terms of long tons. I can speak more directly to a long-ton unit. We are paying approximately $1.40, let us say, as an average figure for the 24-percent ore that we are purchasing. The price schedule sets up a schedule of prices for ore varying from 15 percent to 48 percent with the $2.30 applying to the 48-percent ore. Now, the difference between what we are actually paying of $1.40, say, and the $2.30 for the 48 percent, that represents a certain sum of money which under the procedures for allocating funds under the Defense Production Act would be available for upgrading the ore, for building the mill and paying the operating costs for upgrading the ore. Just what those costs would be, including amortization on the mill and operating cost, is pretty difficult to say at this time.

Mr. FREDELL. That difference we can give them.

Mr. ERICKSON. It is expected that the difference would cover that upgrading operation.

Mr. ADLERMAN. That reserve figure can be given?

Mr. ERICKSON. We can give them the figure we actually paid and the difference between that figure and the $2.30 base price.

Mr. BROADGATE. Is that money actually set up in a reserve fund?

Mr. ERICKSON. It is set up in a fund under the Defense Production Act procedures. Maybe I could outline just what those procedures are.

In the first place there has been no direct appropriation by the Congress for that purpose. Secondly, the Congress has passed the Defense Production Act which provided a sum of $2.1 billion for all the purposes of the Defense Production Act. This $2.1 billion is a

borrowing authority from the Treasury. The $2.1 billion was given to the President who, in turn, delegated the authority to ODM to administer the fund. The ODM has certified programs to GSA and has made available to GSA about $1.25 million of this borrowing authority for carrying out the programs of the GSA.

At this point, I should say that in section 304 (b) of the Defense Production Act, the Congress instructed the President to record obligations on the basis of those transactions and the probable ultimate net cost of each transaction entered into. Now, the gross transactions figure represents the total expenditures under any program and for this Butte-Phillipsburg depot program the gross transaction figure is estimated at $2.30 per unit. We have also made an estimate as to what the probable ultimate net cost of this program would be and in making that estimate we based it upon the purchase price of, let us say, $1.40 per unit, an upgrading cost of 50 cents per unit and from that total—we should also add in there the costs of operating the depot while it is still purchasing the ore such that the total cost of the purchase of the ore, the upgrading and the operation of the purchase depot would amount to $2.30. That figure then was established as the gross transactions and the probable ultimate net cost was established as the total cost of $2.30 less the value of our upgraded product, less the resale value of the upgraded product which might be at world prices something like 70 or 80 cents per unit. The difference between the $2.30 total cost and the 70 cents per unit recovery, would be the estimate of probable ultimate net cost. It is that latter figure which has been established as the obligation of this program.

Mr. BROADGATE. The $16.60 deduction is a flat deduction per ton regardless of the grade of the ore?

Mr. ERICKSON. I cannot speak directly to that $16.60.

Mr. BROADGATE. Perhaps Mr. Fredell knows.

Mr. FREDELL. That is right, that is a flat deduction for certain milling costs and upgrading and I think certain freight allowances in there too.

Mr. BROADGATE. What is the deduction at Wenden and at Deming?

Mr. FREDELL. I believe they are the same?

Mr. BROADGATE. Does anyone know for sure that the deductions are the same at those various stations?

Mr. ERICKSON. I do not know that. That can be furnished for the record, however.

Mr. BROADGATE. It is my impression that the Wenden deduction at least is very much less than the $16.60, but I am not certain and I would like to have that for the record for both of the stations.

Mr. FREDELL. There might be some difference in those deductions. I do not recall offhand, but there might be some difference in deductions based on estimates that were made at the time the program was established on the amenability for upgrading these various products. The Wenden and Deming ores might well have been more amenable and had less processing costs than the Butte ores.

Mr. BROADGATE. That would be an estimate of the Bureau of Mines?

Mr. FREDELL. That would be an estimate of the Bureau of Mines made at that time.

Mr. BROADGATE. Do you feel that the total cost of trying out a final product from the black ores at Butte under your directive would have to be within the $2.30 figure?

Mr. FREDELL. That is the way the program was established, the total cost for it.

Mr. BROADGATE. In other words, if the beneficiation cost was greater than that, you would have to get additional funds?

Mr. FREDELL. We would have to get additional funds.

Mr BROADGATE. Can the black ores at Butte be beneficiated within the $2.30 figure, do you think?

Mr. FREDELL. In this proposal that was submitted to us there was an estimate supplied which indicated that at the present time the cost would be about $2.47.

Mr. BROADGATE. 17 cents more than the present ceiling?

Mr. FREDELL. That is correct.

Mr. BROADGATE. Do you think that it is so much greater that it would not be desirable to go to ODM for the additional authorization for 17 cents?

Mr. FREDELL. We would have to go into it for it in any event. If we knew we could do it for $2.20 or $2.30, in other words.

Mr. BROADGATE. I understand that.

Mr. FREDELL. But whether it was a few cents higher or lower, I do not think would make too much difference in their determination.

Mr. BROADGATE. Or to your recommendation?

Mr. FREDELL. Or to our recommendation, unless it was completely out of line. If it got to 3, or 4, or 5 dollars I would hesitate to ask them to approve any such project as that.

Mr. BROADGATE. Naturally. Coming back to the pilot plant, do you think that the pilot plant, if it were authorized to operate, should be operated by the Bureau of Mines or by a private entrepreneur, like Mr. Griswold, who is thoroughly familiar with the ores?

Mr. FREDELL. I think that any of these pilot plant operations are best handled by people who are familiar with operations, because they are an operating problem. I think that the Bureau of Mines should have people in there as technical consultants, because what we would undoubtedly use and try out in this pilot plant would be processes that the Bureau of Mines has been working on on these ores, and their technicians should be there to direct the technical operation, technical phase of it, but I think that any pilot plant operation had better be in the hands of people who are familiar with operations.

Mr. BROADGATE. This $2.47 figure, is that a Bureau of Mines figure?

Mr. FREDELL. No, that is a figure that Mr. Griswold worked up on a few laboratory tests that he made, using a Bureau of Mines process.

Mr. BROADGATE. He used the Bureau of Mines reagent?

Mr. FREDELL. He used their reagent that they are using, the processing they are using for testing for information for amenability.

Mr. BROADGATE. Do I understand that they are using a new reagent which is excessively costly?

Mr. FREDELL. They have a new process commonly spoken of as an oil emulsion that uses quite a lot of reagent and the reagent costs very high.

Mr. BROADGATE. In other words, if a reagent was discovered which would do the same work and was, we might say, a normal reagent cost as applied to the ordinary flotation process, that this $2.47 cost would come down materially?

Mr. FREDELL. Yes.

Mr. BROADGATE. A great deal in that $2.47 is the cost of the particular reagent?

Mr. FREDELL. That is right.

Mr. BROADGATE. Speaking about carbonate ores which are unique in the Butte district, what is the tonnage of carbonate ores on hand at the present time?

Mr. FREDELL. As of the end of the year they had 35,600 tons.

Mr. BROADGATE. What is the intake?

Mr. FREDELL. Approximately 2 thousand tons a month.

Mr. BROADGATE. If either of these ores were beneficiated in the plant at Butte, what would be the tonnage per day figure?

Mr. FREDELL. It is a 300-ton-per-day plant, I believe.

Mr. BROADGATE. Then with the present stockpile and the intake and considering a period, a shakedown period on the plant, about how long could it operate with what is in sight?

Mr. FREDELL. On the carbonate ores?

Mr. BROADGATE. On the carbonate ores.

Mr. FREDELL. Well, they have 35,000 tons in Butte and they have 11,500 tons in Phillipsburg, close to 46,000 tons in Butte and Phillipsburg.

Phillipsburg would be treated in that same plant.

At 300 tons a day that would be 900,000 tons a month. That would give you a 5 months' operation on the present stock.

Then you have that 2,000 intake. That would be 6 months of full operation.

Mr. BROADGATE. And probably a month's shakedown on the mill?

Mr. FREDELL. So that you might have a complete operation of something like 7 months.

Mr. BROADGATE. Do you think it would be warranted to run that plant for 7 months, considering the outlay for rehabilitation?

Mr. FREDELL. Well, if you rehabilitated that plant for $175,000 on 56,000 tons, that would cost you $3 a ton for rehabilitation cost.

Mr. BROADGATE. It is my understanding, and correct me if I am wrong, that carbonate ores deteriorate with storage. They oxidize perhaps and make recovery more difficult.

Mr. FREDELL. There is a certain amount of oxidation that takes place over a period of time; yes.

Mr. BROADGATE. Do you know what the rate of oxidation is, or the potential loss in recovery due to storage for a month, or 6-month period?

Mr. FREDELL. Over a short period of time I don't think it would amount to too much, because I think that ore would have to be crushed and ground before it went through the flotation plant and in so doing you would be opening up fresh surfaces, whereas the exposed surface would be oxidized.

It would not be a complete oxidation throughout the ore, but it would be a surface oxidation in a comparatively short period of time.

Mr. BROADGATE. You don't think, then, if you stored it for another 2 or 3 years your loss would be equivalent to the $3 a ton to reopen the plant?

Mr. FREDELL. I doubt it. I don't have any definite figures to show that or to prove that, but I would doubt that there would be that much loss.

Mr. BROADGATE. Would you segregate the figures that you furnished the committee regarding the money which is being held against beneficiation as between oxide and carbonate ores?

I would like to know, in other words, how much money ODM could release under the $2.30 figure for this 46,000 tons of carbonate ore, if it would release that?

Mr. FREDELL. I think we can arrive at a figure approximately; yes.

Mr. BROADGATE. Do you have any intention of beneficiating these carbonate ores in the near future?

Mr. FREDELL. There is not a definite plan to reopen that plant immediately; no. There is a definite plan to do some work on the test work.

Mr. BROADBENT. As I understand it, the Bureau of Mines has not done any test work on these carbonate ores, at least in recent years, their work has been on the black ores, the oxide ores.

Mr. FREDELL. I don't know whether they have done any test work on the carbonates or not.

Mr. BROADGATE. They are not continually testing, however, as far as you know, as they are with the oxide ores, where they make for each shipment a beneficiation test, as I understand it.

Mr. FREDELL. I am not sure whether they are beneficiating carbonate ore, making beneficiation tests on those, or not.

Mr. BROADGATE. To your knowledge outside of Anaconda, has anyone got the know-how to beneficiate these carbonate ores except the Domestic Manganese & Development Co. and perhaps Mr. Griswold, as a practical operating matter?

Mr. FREDELL. No; as a practical operating matter those are the only two people who have done any, so far as I know.

Mr. BROADGATE. And they did operate the plant?

Mr. FREDELL. Yes.

Mr. BROADGATE. For an extensive period, in fact?

Mr. FREDELL. That is right.

Mr. BROADGATE. Why, then, is there no immediate plan for starting the mill on these carbonate ores and then perhaps going to the oxide ores excepting perhaps this amortization figure of $3, and is that really important in the picture?

Wouldn't we get experience, for example, at Butte with a plan already there costing only $175,000 to put in shape which might be beneficial as a research and development program, we might say, in handling black ores in other places in the country?

Mr. FREDELL. Black ores; yes.

Mr. BROADGATE. The value of starting this plant then may be much greater than just its value to the Butte area?

Mr. FREDELL. Yes. If they were able to develop a flotation process on the oxide ores it could possibly be extended and applied to oxide ores in other areas.

Mr. BROADGATE. Don't you think perhaps that with a full-scale plant operation it would be much easier to test out reagents and perhaps get a reasonable reagent cost?

Mr. FREDELL. In a full-scale operation; no. That can best be done in a pilot plant operation because in a pilot plant operation you have better control over what you are doing. You don't have that control in a full-scale operation.

Any time you start doing test work in a full-scale operation, you run into trouble.

Mr. BROADGATE. Then taking all these into consideration, it would be smart to start the pilot plant immediately?

Mr. FREDELL. The pilot plant work I think should go on.

Mr. BROADGATE. Thank you, Mr. Fredell.

Mr. ADLERMAN. Mr. Fredell, do you know how the depot proposition was set up in the first place, under what authority?

Mr. FREDELL. Under the Defense Production Act.

Mr. ADLERMAN. Under the Defense Production Act was that set up by administrative ruling or regulation?

Mr. FREDELL. I believe it was by an administrative finding; yes. I think Mr. Holderer, who was head of the manganese section of DMPA at the time that was set up, is more familiar with that setup than anybody around here.

Mr. ADLERMAN. That was set up pretty definitely by administrative action?

Mr. FREDELL. As I understand it, yes.

Mr. ADLERMAN. When they fixed the number of units in each depot, who fixed that unit figure?

Mr. FREDELL. I don't know who fixed it, but I imagine it was fixed by a group of people from probably the Geological Survey, the Bureau of Mines, probably the DMPA.

Mr. ADLERMAN. Again by administrative action?

Mr. FREDELL. That is correct.

Mr. ADLERMAN. By administrative action they change the number of units that should be allocated to each depot; is that correct?

Mr. FREDELL. I presume so; yes.

Mr. ADLERMAN. It is not by legislation that would decree only 6 million units were to be allocated to each depot; is that correct?

Mr. FREDELL. There is no legislation to that effect.

Mr. ADLERMAN. That is purely an administrative finding, it was $6 million for Deming; $6 million for El Paso, and so forth; is that correct?

Mr. FREDELL. That is right.

Mr. ADLERMAN. I have no further questions.

Mr. REDWINE. Your table 5 on the manganese chemical, remarks there show that there is a good deal of work to be done apparently under that contract. I believe that is your testimony, too; is that correct?

Mr. FREDELL. That is right.

Mr. REDWINE. We have testimony here that this plant is definitely in operation; that they are outmarketing their material; they can make battery oxide and they are selling carbonate for the commercial users.

Mr. FREDELL. That is correct, too; but we have a contract—that work to be done under this contract—to supply a certain tonnage to the Government under the contract. That remains to be done.

In the course of supplying that they will continue modifying probably and improving their process in the course of their operations. They don't think that they have the ultimate in their operation at the moment. They just started production in January.

Mr. REDWINE. That is true; they don't believe they have the ultimate by any means, but they were making a product here and selling

it, and apparently from your remarks here there is an inconsistency there that I want to clear up.

Mr. FREDELL. They have work to do there to complete their contract.

STATUS OF RESEARCH PROJECTS

Mr. REDWINE. I have one or two questions on this Mangaslag contract. Was that contract completed moneywise?

Mr. FREDELL. Yes, the amount of money was expended and an additional amount that was supplied by the Government; that was expended.

The company carried on operations for a while with their own money. They just got fed up with putting more money in it. They figured they had gone far enough. They suspended at that time.

They did not want to put any more money into it. Our review of the process indicated that the operation should be stopped at that point while we had a chance to look over the results that had been obtained at the present time, evaluate what had been done for determination that was made as to whether the Government should or should not put any more money into it.

Mr. REDWINE. Has that evaluation been made?

Mr. FREDELL. It has not been completed.

Mr. REDWINE. In other words, the future of that project is still in the laps of the gods?

Mr. FREDELL. That is right.

Mr. REDWINE. Or the Supreme Court.

Mr. ADLERMAN. I have one more thing now to cover.

I would like to get your evaluation or the promise of success in the various research processes that are going on. I know that you cannot to a definite degree, but you could give us your opinion on it.

Take the Mangaslag process, what do you think the promise of success would be on that, if that process would continue?

Mr. FREDELL. Technically I think that the process can be made a success, once they work out the mechanical handling of the process. That is the big difficulty right now.

Mr. ADLERMAN. Do you think that can be overcome?

Mr. FREDELL. I think eventually it can be overcome, yes.

Mr. ADLERMAN. What would your estimate be as to the time element involved?

Mr. FREDELL. I am not a blast furnaceman, but I would judge that they have 4 or 5 years work before they complete that thing, and get it whipped up in any shape.

Mr. ADLERMAN. What is the promise of success in the Nossen process?

Mr. FREDELL. That again is another process that the technology has been pretty well proven. It is a question now of developing the mechanical means of handling the process.

Mr. ADLERMAN. Can that be overcome?

Mr. FREDELL. I am sure that can be overcome.

Mr. ADLERMAN. What is the time element there?

Mr. FREDELL. Well, we are working on a project now that indicates about a year's work. We hope that in that year's work we will have overcome a large part of the mechanical difficulties.

Mr. ADLERMAN. In Dr. King's process, what is the promise there?

Mr. FREDELL. That is a unique process that on laboratory scale holds forth some promise. We are building at the moment a small pilot plant.

Mr. ADLERMAN. That is still in process?

Mr. FREDELL. That is still in progress. How long it is going to take to work it out, I wouldn't venture a guess.

Mr. ADLERMAN. How long will it be before they are successful?

Mr. FREDELL. I think they will probably successfully produce manganese from it and produce some by production, but I doubt if it will be competitive with some of the other processes that are in being.

Mr. ADLERMAN. What is the time element involved there?

Mr. FREDELL. I believe that Dr. King estimates that he has four or more months' work to do.

Mr. ADLERMAN. Do you think he will be able to complete his work in 4 or 5 months, or need longer time?

Mr. FREDELL. In 4 or 5 months he will have some indication as to whether a larger pilot plant is warranted on his process, or not.

Mr. ADLERMAN. How about the Manganese Chemical Corp.?

Mr. FREDELL. That is in production.

Mr. ADLERMAN. What does it look like there?

Mr. FREDELL. Preliminary results look quite favorable. Especially on the special grade manganese products that they can produce with that process.

Mr. ADLERMAN. When do you think they might come up with a somewhat definite answer?

Mr. FREDELL. I would think they should be allowed at least 6 to 8 months' operation before they even asked to estimate what their cost would be.

Mr. ADLERMAN. Does that look like one of the most promising so far of any of the processes for a successful conclusion?

Mr. FREDELL. Yes, it does look like one of the more promising.

Mr. ADLERMAN. Can you give me some idea of the Sylvester process; the promise of success there?

Mr. FREDELL. There again that is a process that we have not got too much to go by, because it has only gone through some laboratory work. There has not been any piloting on it yet.

We are in the process of negotiating a contract for piloting a process. The process appears to have some technical advantages and some technical possibilities for recovery of manganese.

Mr. ADLERMAN. Now, we discussed that somewhat yesterday. What stage is it in now? Has it passed through the GSA and is now with the Academy of Sciences?

Mr. FREDELL. It has been sent over to the Academy of Sciences now for their review.

Mr. ADLERMAN. You would not send it over if you did not think it has some promise of success; is that correct?

Mr. FREDELL. That is right.

Mr. ADLERMAN. Are you able to give us your guess on what the success will be, whether it will be a very successful process?

Mr. FREDELL. Well, if it lives up to the press agents advance notices, it is going to be very successful.

Mr. ADLERMAN. Leave out the press agent. What about the technical promise?

Mr. FREDELL. If it does everything that chemistry shows it is possible to do, why, yes, it should be a successful means. But there again I think it is going to be a high-cost process.

Mr. ADLERMAN. How about the Bruce Williams process?

Mr. FREDELL. That is another process that has only gone through the laboratory stage. The laboratory results that we have seen on it are excellent.

In fact, some of the best that we have seen, I think.

There again if the piloting shows that the process can be handled on operation size apparatus, why, it should be a very successful process.

Mr. ADLERMAN. What do you think the time element will be?

Mr. FREDELL. I think it will be about 18 months if, as, and when we get the contract signed, before we get through the pilot plant stage.

Mr. ADLERMAN. How long will it take to operate the pilot plant?

Mr. FREDELL. That is building and operating the pilot plant, probably 18 months.

Mr. ADLERMAN. On Sylvester, what do you think the time element will be?

LARSEN. Fifteen months.

Mr. FREDELL. I would say 15 to 18 months also, after the contract is signed, and they get ahead to go to work.

Mr. BROADGATE. Do I understand, Mr. Fredell, that you are about to, or will shortly recommend to ODM to start the pilot plant at Butte?

Mr. FREDELL. That will depend on the answer we get from the Bureau of Mines on whether they will undertake this job or not.

Mr. BROADGATE. They are your consulting engineers, of course?

Mr. FREDELL. To a certain extent, yes.

Mr. BROADGATE. If the Bureau of Mines definitely decides to do it themselves, or can't out of their own funds, then will you make a recommendation?

Mr. FREDELL. Then we will probably recommend that some work be done on testing those ores out.

Mr. BROADGATE. You mean start the pilot plant?

Mr. FREDELL. That is right.

Mr. BROADGATE. Thank you.

Mr. HYDE. Gentlemen, I would like to have the record cleared up on the Southwest Engineering Corp. You will recall the statement was made, I believe, to this effect: that we had either by contract or by letter of transmittal undertaken to limit them to the then known process.

Do you recall that statement?

Mr. ADLERMAN. Yes.

Mr. HYDE. Now, Mr. Ford is familiar with that and it is our contention that we did not either by contract or any letter of transmittal directly or indirectly try to limit in any manner the scope of his operation.

Now, I would like to have you hear from Mr. Ford on that matter.

Mr. FORD. The contract, of course, speaks for itself. The first article in the contract is the scope of the performance. It dealt with the various phases, the preliminary phases, which was a review of the literature and the data that was available at the time the work began.

The field work phase was the consideration and sampling of the various deposits, and the test work phase called for a comprehensive chemical spectographic and X-ray spectographic analysis of the ores previous to mineral beneficiation tests and then complete mineral beneficiation tests, including heavy media separation, gravity concentration and flotation with special emphasis on the Robert Lord reagents where required sintering tests would be run.

The scope of the work was taken from the company's proposal as originally submited to do the work so that we did not feel that the scope of the work was limited to merely going over known methods.

Mr. ADLERMAN. Now, I think Mr. Morris' testimony was that they were instructed by one of the Government agencies to stay within known methods. He further said, "I will say our research is limited by instructions from DMPA."

Mr. FREDELL. I think I can explain that a little bit.

Mr. BROADGATE. That is what I wanted to know, whether there were verbal instructions overriding the contract.

Mr. FREDELL. They were given a contract for beneficiation test work, gravity and flotation test work. That is what their contract covered.

In the course of their test work they did not get very encouraging results and did suggest that some of these ores should be treated by leaching, which was outside of the scope of the work that was assigned to them.

We told them that we did not want them to carry on into that other phase of the work; that they were to limit themselves to the field that was assigned to them.

Mr. ADLERMAN. Is that not exactly what he testified to?

Mr. FREDELL. No.

Mr. ADLERMAN. "To restrict ourselves to what is called gravity concentration, flotation," et cetera. The physical methods.

Mr. FREDELL. That is right. That is what we contracted with him for.

You send a few salesmen out to buy shoes, but while he is out to buy shoes he buys dresses—

Mr. ADLERMAN. He was not able to go into the pyrotechnical and hydrometallurgy at all.

Mr. FREDELL. That is right.

Mr. ADLERMAN. In a way he was limited?

Mr. FREDELL. We did not give him the whole waterfront, certainly not. All our contracts are limited to a certain definite piece of work we want done.

We contract for them to do research within a certain area.

Mr. ADLERMAN. I think that clears that up.

Mr. FREDELL. Otherwise we would be getting into this basic business where they get it, somebody would have an idea and they start wandering off on all sorts of tangents and we would have no control and never arrive at any solution on any particular problem.

Mr. ADLERMAN. I suggest that we put the contract into evidence and that will clear the thing up.

Mr. FORD. I think you already have it.

Mr. ADLERMAN. Thank you very much, gentlemen.

(Additional information received for the record follows:)

MANGANESE

ANSWERS TO QUESTIONS SUBMITTED TO GENERAL SERVICES ADMINISTRATION STAFF

1. Question. Submit a copy of Public Law 206 report for March 31, 1955.

Answer. A copy of the Public Law 206 report for March 31, 1955, is attached hereto.

2. Question. How much is invested in the Government-owned manganese plant at Butte, Mont.?

Answer. As of the current date the investment of the United States Government in the milling and nodulizing plant at Butte, Mont., constructed under plancor 1804, is carried at $264,300 for real property and $218,700 for equipment, machines, supplies, etc.

3. Question. What is the deduction for grade per ton of ore at the Wenden and Deming depots?

Answer. The deduction for grade at the Wenden and Deming depots is $10 per long ton of ore received for estimated cost of sampling, milling, and handling. There is an additional deduction of $2.25 per long ton to cover the cost of nodulization of ores containing lead and zinc in excess of 1 percent.

4. Question. How much money is available for processing carbonate ores at Butte, Mont.?

Answer. Funds are available from the Defense Production Act borrowing authority for the processing of carbonate ores at Butte, as well as for processing all other ores acquired under the manganese depot programs. However, obligation of specific funds for such processing can be made only at the time firm contracts are made for such processing. The deduction for grade mentioned in answer to question 3 above, is for the purpose of computing payments on deliveries and is not necessarily reserved for processing.

General Services Administration—Activities under the Defense Production Act, as amended—Quarterly report of purchases under domestic purchase regulations as of Mar. 31, 1955

Pursuant to sec. 4, Public Law 206, 83d Cong., the tabulation below details the quarterly and cumulative purchases under purchase regulation noted]

Regulation	Termination date	Units	Quantity		
			Program limitation	Purchases during quarter	Cumulative purchases through end of quarter
Asbestos	Oct. 1, 1957	Short tons, crude No. 1 and/or crude No. 2, asbestos.	1,500	130	847
		Short tons, crude No. 3		51	384
Beryl	June 30, 1957	Short dry tons, beryl ore	1,500	69	626
Chrome	do	Long dry tons, chrome ore and/or chrome concentrates.	200,000	5,003	82,402
Columbium-tantalum[1]	Dec. 31, 1958	Pounds contained combined pentoxide.	15,000,000	1,729,880	9,084,159
Manganese:					
Butte-Philipsburg	June 30, 1958	Long dry ton units, recoverable, manganese.	6,000,000	276,319	1,440,006
Deming	do	do	6,000,000	536,769	2,307,346
Wenden	do	do	6,000,000	807,981	5,406,209
Domestic small producers.	do	Long dry ton units, contained, manganese.	19,000,000	449,689	2,725,306
Mica	June 30, 1957	Short tons, hand-cobbed mica or equivalent.	25,000	687	5,503
Tungsten	July 1, 1958	Short ton units, tungsten trioxide.	3,000,000	217,402	1,677,453

[1] Columbium-tantalum regulation provides for both domestic and foreign purchases. Report includes both. Foreign purchases will terminate close of business Dec. 31, 1956.

Mr. ADLERMAN. We will now call Mr. Cole.

STATEMENT OF J. H. COLE, DOMESTIC MANGANESE & DEVELOPMENT CO., BUTTE, MONT.

Mr. ADLERMAN. Mr. Cole, will you state your full name and connection?

Mr. COLE. John H. Cole, manager, Domestic Manganese and Development Co. at Butte, Mont.

Mr. ADLERMAN. Do you have a prepared statement, Mr. Cole?

Mr. COLE. No, I do not. I would like to submit one later.

Mr. ADLERMAN. Will you proceed to make a verbal statement?

Mr. COLE. I have been in the manganese business since 1917. I have been in it continuously since that time.

In 1927, myself and associates built a nodulizing plant at Butte, Mont., to treat the high-grade manganese carbonate ores belonging to the Anaconda Copper Mining Co. at Butte, Mont.

This high-grade crude ore, as purchased from the Anaconda Copper Mining Co., averaged about 37½ percent. In nodulizing this product, we had a recovery, crude ore to nodules, of 94½ percent.

We operated this plant from 1928 through 1941. We produced between 250,000 and 300,000 tons of manganese ore, an average manganese content of better than 58 percent with the silica plus alumina content below 11 percent.

We never received more than 61 cents per unit for this high grade ore delivered to the United States Steel Corp. at Pittsburgh, Pa., and Birmingham, Ala. We also sold large quantities of ore to the E. J. Lavino Co. of Philadelphia, Pa., and paid the freight when shipping to this company to Reusons, Va., and/or Sheridan, Pa. We also shipped large quantities of this high grade nodulized manganese to the Colorado Fuel and Iron Corp. at Pueblo, Colo., and on several occasions sold this ore as low as 40 cents per unit delivered at Pueblo, Colo.

This high-grade manganese ore was exhausted at the end of 1941.

The War Production Board requested the Anaconda Copper Mining Co. to go into the concentrating and nodulizing of manganese ore. They also requested that we enter into a contract with the Defense Plant Corp. and Metals Reserve for erection and operation of a flotation mill in connection with our nodulizing plant to treat the manganese ores which were to be purchased by Metals Reserve from the small producers in the Butte and Philipsburg districts. We entered into a contract with Defense Plant Corporation to build the flotation mill and entered into an agency agreement with Metals Reserve to operate their new flotation plant as well as our nodulizing plant for the Government.

We operated these plants during the war and produced from 151,000 tons of oxide and carbonate ores 29,000 tons of nodulized material, averaging about 51 percent manganese. We also produced a considerable amount of gold, silver, lead, and zinc from the manganese carbonate ores purchased by Metals Reserve.

We worked all of the better ores during the war and in 1949; 3 months of 1949 and 3 months of 1950 we produced, or we processed, 40,000 tons of ore which was purchased by Metals Reserve, but was not processed by ourselves during the war.

The combined tonnage treated by Domestic Manganese and Development Co. for the Government was 192,000 tons, which we proc-

essed during the years 1943 through 1945 and 3 months of 1949 and 3 months of 1950.

The average grade of all the nodulized product produced by Domestic Manganese and Development Co. for the Government was better than 50-percent manganese and meets the Government specifications in all respects.

From the experience gained during the war and the period of 1949 and 1950, myself and several other producers of the Butte-Philipsburg district were called to Washington by Dr. Boyd, then Administrator of the Defense Materials Administration, and it was at this meeting that I was asked by Dr. Boyd and Phil Bradley, who was then the acting head of the manganese branch, to work with a couple of the metallurgists who were then employed by Defense Minerals and come up with a price which I thought would bring forth production under the Defense Production Act.

After several days' work, we came up with a figure of $2.35 per unit for Philipsburg manganese carbonate and $2.25 for Butte manganese carbonate.

It was later decided that $2.30 would be the price and it was not only adopted for the Butte-Philipsburg district, but it was also adopted for the Wenden and Deming depots, as well as the nationwide 19 million-unit program.

I want to make it very clear that it was the experience that we gained during our World War II operation for Metals Reserve and our 1949–50 operation that allowed us to come up with this $2.30 price.

The actual unit price for the period of 1943 to 1945 for the production was $1.75 a unit, which included the cost of ore. The material we produced in 1949 and 1950 brought this price up to $1.94 a unit, which also included the cost of ore.

Of course, that is some 36 cents a unit cheaper than the Government is paying today under the different manganese programs.

I wish further to state that the Bureau of Mines is making recoverability tests on oxide ores on which payments are being made at the Butte-Philipsburg depots which have an overall recovery through December 1954 of approximately 88 percent.

This a much better recovery than Domestic Manganese & Development Co. has ever been able to obtain for an average on either oxide or carbonate ores. When I talk about Domestic Manganese & Development Co. recoveries I speak of actual plant recoveries not laboratory recoveries such as the Bureau of Mines use. However in this connection I wish to point out that the ores we have processed for the government have all been blended before flotation. It is, therefore, my thought that better recoveries can be had if blending takes place after flotation and nodulizing rather than beforehand.

Nevertheless, if these Bureau of Mines figures can be duplicated in a pilot plant operation and then proven by a plant operation, the Philipsburg-Butte district will produce nodulized manganese ore for less than $2.30 a unit.

If these recoveries cannot be maintained, then no one knows at the present time what that unit cost will be.

It is my thought that so long as we have a pilot plant at Butte and Domestic Manganese & Development Co. owns part of the plant and the Government owns the other part, that the sooner the tests are

made, the better off the shippers, the Domestic Manganese & Development Co. and the Government will be.

Up until the time the Bureau of Mines started to test the oxide ores for the General Services Administration, it was unheard of to make better recoveries on oxide ores than you could on carbonate ores in the Butte district. If pilot plant testing on oxide and carbonate ores, plus 3 months actual operation of the plant, proves that the Bureau of Mines recoveries on oxide ores are correct, and that better recoveries can be had on carbonate ores, then the producer of carbonate ore is being underpaid and the price should be adjusted.

However, before any price adjustments, let there be no misunderstanding, there should take place, in my opinion, a pilot plant operation and then a full-scale plant operation and, again I repeat, for a 3-month period. We have the facilities at Butte and the whole thing can be settled within the 3-month period referred to.

There have been almost $2 million [1] set aside now under this $16.60 treatment charge for both carbonate and oxide ores. That is ample money, and as I understand, way back in 1951 there was over $11 million appropriated for the Butte-Philipsburg manganese program.

At the present time the oxide shipper is either being overpaid and/or the carbonate shipper is being underpaid, and, in either event, these prices should be adjusted. They cannot be adjusted on laboratory testing such as the General Services Administration are now using for supplemental payments to the producers. The reason for this statement is because some ores are sintered by the Bureau of Mines and some are not and there is no apparent reason why they should not all be sintered (nodulized).

I was amazed to learn of all these different processes. It is my belief that if the Bureau of Mines flotation recoveries can be duplicated, or nearly so, there should be no more money spent on any of these manganese processes that are unknown as far as Montana manganese ores are concerned.

Certainly the Anaconda Copper Mining Co. and ourselves have proven flotation on Butte carbonate ores.

I don't take in the Philipsburg carbonate when I make that statement because of the high lime content in Philipsburg carbonate ore, nor do I include any high lime that may be developed in the Butte area. Additional pilot plant tests are needed on the Philipsburg carbonate ores.

Why do you want to look for a process that will give you better than a 97 percent recovery in a lot of cases and an average of 88 percent? If they can do that, they are going to improve; they are going to improve the average above 88 percent because we have lots of tests that come back between 95 percent and 99 percent.

Mr. BROADGATE. You are speaking of oxide ores?

Mr. COLE. That is right.

The Bureau of Mines make no test on carbonate ores. That is all settled on the prices which I set up for Jess Larson, who was then Administrator of the General Services Administration.

Mr. BROADGATE. May I ask you if you agree with the General Services Administration on that $2.40 price for beneficiation?

[1] $2 million is through April 14, 1955.

Mr. COLE. I agree, but this only tells part of the story. You referred no doubt to Mr. Griswold's statement when you made that, Mr. Fredell.

When this program was set up it was on a 50–50 basis between Butte and Philipsburg. On Butte ore we have added the freight rate from Philipsburg to Butte. Mr. Griswold's report did not take into account the freight rate on a 50–50 basis. If he had, his unit price would be less than $2.40 per unit.

Mr. BROADGATE. This figure of Griswold's does not include the credit for freight on a 50–50 basis?

Mr. COLE. That is right, from Philipsburg to Butte. When you take 50 percent from Butte and 50 percent from Philipsburg, then that unit cost is down below that $2.30.

Mr. BROADGATE. This figure is based on the Bureau of Mines average recoveries?

Mr. COLE. No, not this figure.

Mr. BROADGATE. That is based on Griswold's recoveries?

Mr. COLE. That is right.

Mr. BROADGATE. Is there any substantial difference?

Mr. COLE. I think they did very well, between 7 and 8 percent difference in the recovery.

If they had been working together, maybe they would have hit it on the nose. I think it was remarkable that they came out as closely as they did on this particular ore.

Mr. BROADGATE. I think I failed to ask Mr. Fredell what was the estimated cost of beneficiation of the carbonate ores? Do you have a unit estimate?

Mr. COLE. Yes.

Mr. BROADGATE. As of today, with today's costs?

Mr. COLE. I am going back a ways. In August of 1952, Jess Larsen asked me to prepare what I thought would be a fair figure for the Butte-Philipsburg oxide and carbonate programs to operate. I will read this letter if you do not mind. It is Defense Materials Procurement Agency, Washington, D. C., August 21, 1952:

JOHN H. COLE,
Domestic Management & Development Co., Butte, Mont.

DEAR MR. COLE: Your letter of August 7, 1952, has been received and I have noted its contents with great interest. In view of your interest in this purchase program I wish that you would furnish me with the price schedule or schedules which in your opinion would be most practical and equitable for the Butte-Philipsburg programs and you, as the processor of the purchased ore, and working on your schedule, I suggest you treat carbonate and oxide ore in the same classification, the base price of $2.30 per unit must be considered as the maximum the Government will pay for the processed material, which price will include upgrading, sampling, handling, and in the case of Philipsburg, transportation from Philipsburg to your mill. In other words, the price schedule will be figured which, when the cost of upgrading, sampling, handling and transportation is added thereto, will not exceed $2.30 per long dry-ton-unit or manganese. Standard premiums and penalties should apply to the respective ores, carbonate and oxide ores.

Sincerely,

JESS LARSEN.

On September 17, 1952, I answered Mr. Larsen's letter with a 27-page letter and exhibits running through the alphabet. From those exhibits a lot of study was given by the staff here, and an engineer by the name of Waite was sent to Butte in December 1952.

The oxide program was published in the Federal Register, January 17, 1953, after Mr. Waite went over these figures with me. They are published exactly as I set them up.

The only bad thing about it, they added a recoverability feature to it which, in my opinion, was a little too loose. This has worked to the disadvantage of the producer as well as the Government.

I think it is high time this program should be corrected.

Pilot plant tests can be made in 30 to 60 days. By that time this plant could be put into operation and it will not require, for a short operation, the sum of money Mr. Fredell states.

Mr. BROADGATE. Mr. Cole, I think GSA seems to be in agreement with you that there should be a pilot plant operation. I see no reason why the committee should not recommend if that operation is successful, the adjustment of the purchase rates.

But I would like to get down to the cost of what would be the present cost of milling and nodulizing those carbonate ores.

Mr. COLE. If there is no more stockpiling we can stay within the $2.30. You cannot go back and pick up any of these stockpiling costs, but if you started the plant tomorrow you can stay within, on the carbonate ore, the prices that I set forth in these exhibits. That is the $2.30.

Mr. BROADGATE. You do not have an exact figure?

Mr. COLE. For processing?

Mr. BROADGATE. The overall cost of processing the carbonate ores?

Mr. COLE. Yes; the $16.60 and we still can do it for that.

Mr. BROADGATE. You would be willing to take a contract at the flat price?

Mr. COLE. I would be if we were sure what was going to happen to these oxide ores. I would not like to take a contract tomorrow morning at the $16.60, and only have a 4 or 5-month operation in front of me. However, if I was assured of a continuous operation on the oxide and carbonate ores purchased by the Government at Butte and Philipsburg, then I would be willing to do the job for $16.60.

Mr. BROADGATE. Milling both the carbonate and the oxide?

Mr. COLE. That is right.

Mr. BROADGATE. You think that the oxide cost could be kept below this $2.47?

Mr. COLE. I do. I am hoping, of course, that these reagent costs of the Bureau of Mines will be lower.

Mr. BROADGATE. I was going to ask you about that. Is there not a feasible chance that if Griswold operates a pilot plant he might be able to find a reagent of a lower cost?

Mr. COLE. I think that if the pilot-plant work is finally agreed to be done at Butte, that the Bureau of Mines people who have been conducting these laboratory tests should work with Griswold. There is no question in my mind but what this work should be done at Butte and done immediately.

Mr. BROADGATE. Do you see eye to eye with GSA on the cost of beneficiation?

Mr. COLE. Now, just what do you mean by that?

Mr. BROADGATE. You probably discussed this matter with them. If they were going to beneficiate these ores, do they think that you could come out even on the $16.60 contract?

Mr. COLE. I know certainly they did when they published these figures, or they would not have published them. They certainly were in full agreement with me at the time.

Mr. BROADGATE. That was in 1952?

Mr. COLE. And again in 1953.

Mr. BROADGATE. Labor costs have risen since that time.

Mr. COLE. A little; yes.

There is one thing about it that will help in that situation. In these $16.60 treatment costs there is no freight paid by the Government, only on ore from Philipsburg to Butte.

I, by the way, am a contractor for General Services Administration and prepare all the statements and sample and stockpile the ore under the stockpiling program, so I know we get shipments from California, Nevada, Utah, Idaho, and different parts of Montana.

All those people must pay their own freight rate. The only freight rate that is paid by the Government is from Philipsburg to Butte, which is included in this $16.60 cost.

So we do have a little extra money in that $16.60 to apply on higher reagent costs and additional labor costs.

Mr. BROADGATE. I would like to pinpoint this thing in a definite statement. On the carbonate ores you believe that the total cost, purchase and beneficiation, will be within the $2.30 figure?

Mr. COLE. I do.

Mr. BROADGATE. You would be willing to contract, provided you could get a long enough run, to beneficiate these ores, both oxide and carbonate, at a $16.60 flat rate figure per ton?

Mr. COLE. That is right.

Mr. BROADGATE. We do not want to confuse the unit and ton prices.

Mr. Fredell is still here and I would like to ask him if, provided it was determined that these ores should be run, he thinks that General Services would consider a flat rate contract of that type and at approximately that price.

Mr. FREDELL. We would be glad to consider a flat rate contract with certain provisions on guaranties of recovery. We would certainly want to have a recovery guaranty in there.

We would not consider any kind of contract. As far as the price is concerned, I'm not prepared to say what price we would consider. We would have to make a very careful review and estimate of all costs before we would consider the price.

Mr. BROADGATE. What would you think would be a fair average overall recovery that GSA would consider to be fair?

Mr. FREDELL. Well, their previous operation showed an overall recovery of something on the order of 68 percent, I believe, on their carbonate; 69 percent.

Mr. FREDELL. I don't think that is a good recovery. I don't think we should go into an operation and get 69 percent recovery.

Mr. BROADGATE. Can you better that, Mr. Cole?

Mr. COLE. We can better that on Butte carbonate ore.

Mr. BROADGATE. Which is the majority of the ore you have on hand?

Mr. COLE. At the end of December 1954, we had approximately 34,000 long dry tons of manganese oxide ore stockpiled at Butte. At the end of December 1954, we had approximately 35,000 long dry tons of manganese carbonate ore stockpiled at Butte. At Philipsburg

we had approximately 11,500 long dry tons of manganese carbonate. During the months of January, February, and March 1955, we received approximately 20,000 long dry tons of oxide and carbonate ores at Butte.

If these Bureau of Mines recovery figures can be maintained in plant operation, certainly we can better our old recovery figures on oxide ore.

You know, when we first treated oxide ore we only had a 20 percent recovery. That was in 1943 and 1944. Then in 1949–50 we had a 37½ percent recovery.

Now, the Bureau of Mines have that up to 88 percent recovery.

Mr. BROADGATE. Let me ask Mr. Fredell: Based on the Bureau of Mines laboratory figures which might not perhaps be maintained in the mill, what would you think a proper recovery point would be before you would think it economical to run these ores?

Mr. FREDELL. I think that the stuff they are showing at 88 percent recovery in their laboratory would probably turn up somewhat in the neighborhood of 80 percent in the operation, if they had a good operation. That has been my experience, that laboratory results are usually very much higher than anything you can get in an operating plant.

Mr. BROADGATE. Would you think, then, that GSA would consider it if the pilot operation showed an 80-percent recovery?

Mr. FREDELL. If they showed an 80-percent recovery, then you would be in what might be considered reasonable metallurgical results.

Mr. BROADGATE. You feel that could be maintained?

Mr. COLE. During the war when we made better than 50-percent recovery, we were subject to working a thousand tons of ore from one district. When this test was completed, we were subject to working a thousand tons from another district. Then we might be ordered to make a test on a mixture of several different ores. Under these conditions I think we were quite fortunate, and I know the Government was fortunate, we were able to come up with better than a 50-percent recovery and a total unit cost (which includes ore and processing) of $1.94 covering the war period and the part-time operation of 1949–50.

So you can see to get better than a 50 percent recovery out of all of the ore that Metals Reserve purchased we were doing a pretty good job. It was an experimental plant and that is what it should be today. I again wish to state that Metals Reserve purchased approximately 192,000 tons of low-grade manganese oxide and carbonate ores. This ore was all processed by the Domestic Manganese & Development Co. from late 1943 through October 1945 and 3 months of 1949 and 3 months of 1950.

We made from this 192,000 tons approximately 37,000 tons of nodulized manganese ore which averaged, when blended, better than 50 percent manganese and meets Government specifications of today in every respect.

We also produced some manganese carbonate concentrates, which were shipped to a fertilizing company, in the south, at the direction of Metals Reserve, and a considerable tonnage of lead, zinc, silver, and gold, which netted the Government 56 cents per long dry ton of manganese purchased.

During the World War II operations of 1943 through October 1945, and the 1949–50 operations, we obtained, from the 3 periods, an aver-

age unit cost of $1.94 which includes the price of the ore. Our recoveries were not too good, however, they were plus 50 percent, crude ore to nodules, and our unit cost, I repeat, was $1.94 or 36 cents per unit cheaper than the Government is paying for manganese ore today.

There is a great difference in recovery when you process ore from one mine or 75 mines and from entirely different areas and structures. A glance at the Bureau of Mines laboratory testing on which the Government is making supplemental payments based on recoverability tests will prove this statement.

The average grade of nodules and mill concentrates, since December 1953 (which was the date Supplementary Settlements on oxide ore, based on recoverability tests, by the Bureau of Mines, became effective) is 44.79 percent. Of course if you want a product lower than 50 percent manganese we too can make a greater recovery by simply sacrificing grade for recovery.

Mr. BROADGATE. Now, considering Mr. Fredell's statement that there would be a very limited run on carbonate ores, probably 6 or 7 months, would you recommend starting the plant and making the expenditure for rehibilitation just on the carbonate ores?

Mr. COLE. Yes; I would.

Mr. BROADGATE. How do you justify it?

Mr. COLE. I justify it because our stockpiling costs at the inception of the stockpiling program were as high as $20 a ton because of very low tonnage receipts. Now, we have that overall cost down to around $3.50 a ton. If we do not start the plant we are going to have to get new ground and after sampling haul the material out of our plant, maybe a mile, which costs money, and it will add to the cost of stockpiling.

Whenever you are receiving ore at the rate of from 6,000 to 9,000 tons per month it does not pay to stockpile, and then at a later date pick it up at another additional cost. (We received 20,000 tons of manganese ore during the months of January, February, and March.) From now on we will receive ore at approximately 9,000 tons per month. We have proven that it does not pay to blend ore from so many different mines before same is treated. Therefore, with the limited space we have for storage, without additional cost, it would be to the advantage of the Government to get the Butte plant going and this will prove to be beneficial to all concerned at a later date.

Mr. BROADGATE. What do you say to that, Mr. Fredell, the cost of stockpiling as against starting the plant?

Mr. FREDELL. I could not give you an offhand statement. You would have to sit down and figure that out, balance one against the other. You know what it costs to stockpile your ores. It would be a question of what the cost of running your plant at the particular time on a low recovery or wait until you get a better recovery, determine then whether your increased recovery would offset your stockpiling cost. It is a question that would require considerable study to determine.

Mr. BROADGATE. I gather that GSA has not made such a study and does not actually know whether it will be beneficial to start that plant or not.

Mr. FREDELL. That is right.

Mr. BROADGATE. Will GSA do that and furnish the information to the committee?

Mr. FREDELL. We probably will in connection with our pilot plant studies.

Mr. BROADGATE. Good. Do you have anything further to say, Mr. Cole?

Mr. COLE. According to Griswold, it will take him 38 days to work 6 different ores from the largest producers we have—these oxide ores—and come up with answer.

Mr. BROADGATE. Is that not a rather short pilot plant period?

Mr. COLE. Well, the plant is already built. Mr. Irving Gumbel, formerly of GSA, wrote me a letter dated March 1, 1955, asking for the scope and cost for the proposed pilot plant testing. Mr. Fredell's office has a copy of my letter dated March 15 and attached thereto is a copy of Mr. Griswold's estimate of cost and time to make tests. Griswold's letter states 38 days.

Mr. FREDELL. I would like to make a suggestion here in reference to that. Griswold's proposal is to use a process which the Bureau has now developed and to run tests on 5 or 6 different ores, using that 1 particular process. I don't know whether that is the best process for those ores and neither does anybody else. I don't think the thing should stop with just running a few tests through the pilot plant, just because you are running it a thousand-pounds-a-day test instead of a bigger size test.

That does not answer the question. You have to run through a number of different processes, through that pilot plant.

Mr. BROADGATE. How long do you think that would take?

Mr. FREDELL. I should say that pilot work should be carried on for probably 6 months to a year using various processes before you settle it, unless by any chance this thing turns up with something startling to start with, then you are satisfied, you go ahead from there, you carry on laboratory work which would be translated to your pilot plant later.

Mr. BROADGATE. You would expect to better that 80-percent recovery?

Mr. FREDELL. We always hope to better it. You are never satisfied.

Mr. COLE. Wouldn't you be willing to start a plant on an 88-percent recovery if it could be duplicated?

Mr. FREDELL. If it could be duplicated; sure I would.

Mr. COLE. This whole program was based on a much lower recovery than that. If you are going to keep on like Senator Malone said yesterday, we have been 30 years here trying to do something; you have a plant out there; you have the ore, and if you can make an 88-percent recovery, now is the time to do it.

Mr. FREDELL. If you can make an 88-percent recovery, I have no argument.

Mr. COLE. I don't know whether you can make it. As you know, the Bureau of Mines average recovery on oxide ore through December has been better than 88 percent. Supplemental payments, based on laboratory testing have been, and are being made by General Services Administration to the shipper on this basis. The reason I state that I don't know whether or not this 88 percent can be duplicated is because there have been a great many supplemental payments made on the basis of a concentrate rather than a sinter. You know the Bureau of Mines flotation process requires an extremely fine grind and any flotation process requires grinding so fine that the material must be sin-

tered or nodulized for metallurgical purposes and it will have to be sintered or nodulized before industry would attempt to use it. Further, when sintering loss is not taken into account before payment is made to the shipper then, of course, your $2.30 unit price will not hold nor will your recovery figure of 88 percent. The Butte-Philipsburg manganese program was set up on a finished product or a nodulized basis, not concentrates. In other words it is crude ore to nodules, not crude ore to concentrates. If the Government pays on a concentrate basis, then they automatically raise the price of the crude ore.

The price of $2.30 per unit is the best price ever known for manganese and certainly all of the producers in the Butte and Philipsburg area want to do whatever is necessary to preserve this unit price of $2.30. I mean by this statement that no producer expects to be paid for greater recovery than can actually be made in the plant operation. I say, let us prove it and not take 10 years to prove it.

Mr. BROADGATE. Mr. Fredell has said they are ready to recommend pilot plant operations and it should be possible to prove it within a reasonable time. The first thing is to get the pilot plant going, it seems to me. Do you have anything further to say?

Mr. COLE. Yes; let me clear up the treatment cost of $16.60.

Referring further to the $16.60 treatment charge, I wish to state that at the end of January 1955, the Government has purchased 87,887 long dry tons of oxide and carbonate ores at Butte and Philipsburg, Mont. This tonnage multiplied by $16.60 per ton equals $1,458,938.60. This money does not have to be appropriated. It is money set up as a treatment charge and covers ore delivery, freight costs from Philipsburg to Butte, milling, nodulizing, fixed fee to the contractor (Domestic Manganese & Development Co.), overhead, etc. This money was set up and withheld from shipper for processing the manganese ore purchased. See Jess Larson's letter to me dated August 21, 1952, and quoted in full above, when my figures amounting to $16.60 treatment charge was published in the Federal Register, it became a part of the manganese regulations for the Butte-Philipsburg districts which cannot be interpreted in any way but being a treatment charge.

The Domestic Manganese & Development Co. can stay within the $16.60 treatment cost if all the ore purchased by the Government is processed at one time and without undue interference by the government such as was encountered by my company during the part-time operation of 1949–1950. The new reagent costs are considerably higher on the oxide ore. The reagent costs on the carbonate ore are not as high as those used for oxide ore and, of course, there is a savings on freight from points other than Philipsburg. With these factors in mind, it is my belief that the $16.60 treatment charge will stand, however, pilot plant testing on both oxide and carbonate ores will more or less prove this and a 3-month shakedown run in the plant itself will definitely prove what can be done.

I wish to further call your attention to the fact that the $16.60 treatment cost is being withheld from the shipper on every ton of ore purchased at the Butte and Philipsburg depots and has been withheld from the shipper since the inception of the program.

Mr. ADLERMAN. Thank you.

Mr. HOLDERER. I have this suggestion, that we are never going to get going unless we get started. That sounds so simple, but we have been an awfully long time getting started on something.

Mr. BROADGATE. I think you are perfectly right on that. Mr. Fredell seems to agree with us so far as the pilot plant is concerned. I hope they get an authorization for that very shortly and we will at least have one project started.

Mr. COLE. There is one thing about this project; you can make some money on this one. You will at least get some ore back that will meet Government specifications. It will be different from the experimental projects I have heard of here in the last day or two. You can treat this as an experimental job and go at it tomorrow morning and you really will get some high grade nodulized ore back.

Mr. ADLERMAN. Thank you very much, Mr. Cole.

We will adjourn until two o'clock.

(Thereupon, at 12:30 p. m., the committee was recessed, to reconvene at 2 p. m., same day.)

AFTERNOON SESSION

Mr. ADLERMAN. Mr. Stringham, will you come forward, please.

STATEMENT OF WILLIAM S. STRINGHAM, BRUCE-WILLIAMS LABORATORIES, JOPLIN, MO., ACCOMPANIED BY C. BROOKER POWELL, COUNSEL

Mr. STRINGHAM. My name is William S. Stringham, consulting metallurgist, attached to the Bruce-Williams Laboratories of Joplin, Mo.

Mr. ADLERMAN. Would you give your name, please.

Mr. POWELL. C. Broker Powell, attorney, Denright Building, Washington, representing Bruce-Williams.

Mr. ADLERMAN. The ores beneficiating company, is that associated with Bruce-Williams?

Mr. STRINGHAM. Yes, sir.

Mr. ADLERMAN. What is the connection?

Mr. STRINGHAM. President of Beneficiating Co.

Mr. ADLERMAN. Do you have a research process underway?

Mr. STRINGHAM. Yes, sir.

Mr. ADLERMAN. Will you explain the nature of that process. Do you have a prepared statement?

Mr. STRINGHAM. No, sir.

Mr. ADLERMAN. Will you explain the nature of your process, please.

Mr. STRINGHAM. You take your ordinary ores as is or medium-grade ores of around 15 to 20 percent. They are ground fine, about a minus-100 mesh, depending entirely upon the ore. If they are the ores of the Aroostook County or slags, the grind has to be fine enough to allow leaching to take place within the particle itself. So, therefore, we put the limit on those two particular ores at minus-150 mesh.

The ores are mixed with chemicals—in some cases, two—mostly in the ores of the South, south of the Mason-Dixon line, clear to Nevada, those ores and the black ores of the Cuyuna Range.

There are two chemicals mixed with the ore as intimately as we can by dry mixing. The ores are then subjected to a low-temperature

roast not to exceed 1100° F. This roast is conducted for about 1 hour and 45 minutes to a maximum on the Maine ores and the slags. It takes about 3 hours in the furnace. The furnace is more or less a dead atmosphere, as near as we can carry it with the ordinary pressure. That would be, it is actually at atmospheric pressure. There is no pressure in the furnace, but we try to get the gases as dense as possible, as thick as possible, as dense as we can in there.

The excess gases, along with the uncombined gases, come through the furnace and absorb directly in the absorption column. The calcine, which drops out of the furnace through an ordinary trap, it is a trap furnace both on the feed and on the outlet, we will say similar to the pelletizing furnaces in existence up on the range, some of the furnaces.

The calcine is then ready to leach the manganese. The leaching can be done either by water, just straight water, or, if your iron is very high in the ore that you start with, you get some solubility there. So we use the effluent liquor that comes from the primary absorption column to leach the calcite. That leaching takes place in from 15 to 30 minutes. You can build up your salts in solution to around 100 to 175 grams of manganese per liter. Then you agitate that, and where you have high iron dissolution you agitate it with air so as to oxidize your iron, and it precipitates as a hydrate. It is oxidized over the ferric state.

This is followed by a normal washing, just normal, in any chemical recovery. For instance, the best I know of is zinc leaching for zinc electrolytic precipitation, and also what I used to do as a kid in the cyanide plants where we washed the solutions to get out the soluble values.

You had then a solution which we precipitate with CO_2, with a manganese carbonate, a very easy precipitate to handle, and that is washed also to get salt recovery. It is filtered, ready for the drier—whatever you want to do with it. It is very high grade.

On the ores we have treated we have had no trouble with making 64 percent, 63 percent on some of the slags where you have a high soluble iron content. But our average end product in manganese was around 67, 65 to 67 percent, not running on a total oxidizing calcination. If you run a little on the reducing side you will run around 65 to 67.

On some of the ores we use a third chemical, but in the process the chemicals are recovered. There is no sleight-of-hand performance in it. It is a low-temperature roast, as we call low-temperature work—1000° is low temperature, Fahrenheit.

Salt recovery, chemical recovery is standard. Absorption column for the gases, which are all highly water soluble, and washing is the normal practice in practically every hydro-millage process there is.

Calcination of manganese carbonate doesn't have to be gone into. It has been gone into.

We can sell a high-grade manganese carbonate if we want to. Or, if we want to go to an oxide, it is a very common step, and we would probably do it to recover some carbon dioxide to reintroduce into the system. That is purely a question of economics at that point.

This process wasn't happened at by just a streak of luck. Part of it was. One in particular, the last chemical, was just "try this." We tried it, and it worked. The other two are purely simple deduction,

and after about 3 years of very good study on the whole manganese setup.

We finished putting in a zinc leaching plant, I myself. And I became fairly ill—I was in bed for a while. But I got up; was still kind of puny, but I couldn't stay away from the laboratories. We worked. I started working on this. First we ran an economics survey. I had always been used to fooling with lead and zinc and copper and phosphate rock.

Mr. Williams said, "While you are resting up run an economics survey on manganese. You might be surprised."

Well, I did and found out the normal grade of ores around over the country—supposedly a misnomer in the manganese industry, as they call that low-grade ore, that ore that can't be concentrated. It might be very high and normal from a lead and zinc standpoint, just bonanza grade. Sometimes actually low-grade ores are known as the high-grade ores because they can be concentrated to meet, we will say, P–30 specifications. They are normally what is known as hard ores.

Applying the value per pound to—well, one of the best known of the low-grade ores, known all over the country, the common term is wad ores. They are supposedly low-grade ores. A low-grade wad ore is 12 percent manganese. That is a low-grade wad ore. I mean that is low grade in manganese. If you had a 12-percent zinc mine you would really have it. Figuring even on the world price, we would set it at a dollar a unit for easy figuring. In other words, we will also figure in the short-ton units because it is easy. That makes your manganese worth 5 cents a pound.

Well, gentlemen, I mined many a ton of zinc ore and I have made concentrates out of thousands and thousands of tons of zinc ore at 5 cents a pound in the interior of Mexico, and I don't think if any of you have ever worked for the A. S. & R., they don't very often keep a unit going that is not making money. We made money on 4-cent lead, 5-cent zinc. So we didn't have 15-percent zinc either.

The reason I say zinc as an analogy, the subsequent metallurgy of zinc, you make a concentrate of 45 to 60 percent. Then really the cost starts to mount on zinc. You have smelting costs, actually running up to around $30 per ton in some places—well, it is over that. Mexican costs are higher than that where we have to go to coal, where you have real low grade gas, which they don't have much more—your costs might be $30, but most are higher than that.

So that the analogy that I worked on was, well, we have got a zinc ore with a gross value at 5 cents a pound. At 20-percent zinc, which is on wad ores, and we will say refractory manganese ores of the type we will say that is in the depots in the South and in the stockpiles there, and a 15-percent ore similar to the Cathadin group in Aroostook County—still many, many millions of tons of 15-percent ore up there.

You have a gross value on ore of $15 to $20, that that ton of ore is worth.

Now going back again to the analogy of gold ore, silver or lead and zinc, if you can develop a head value of any kind of tonnage of $5 a ton you have certainly got a mint to work on. You will say, "Oh, those metallurgical problems, you can do that."

I remember the days—I have worked in the first flotation plant outside of the Butte and Superior plant, but I worked in the first flotation plant in the United States as an operator.

Take copper, for instance. We used to make head 12½-percent copper concentrate and thought we were doing very good. Now, then, that same ore, they make 35, sometimes better. So that, in figuring further on that economics study, I said, "Some of you guys are sure dumb Doras, and if we can't start out with a $15- or $18-head ore and come up with an answer on it, the answer on a lot of it is that you can't so far—" I don't say can't in the metallurgical game. You can't bring it up anywhere near P–30 specifications.

So that throws out a lot of ores, big tonnages, where gravity concentration—when I say gravity I say mechanical concentration—really doesn't beneficiate the ore at all. Therefore, it had to do, you had to attack the problem from a pyrometallurgical standpoint or chemical standpoint.

I had had some experience on the development of the taconite furnaces on the pelletization of the taconites, and I knew that the heat requirements alone, where you have to get into semiblast furnace work, you are up against a terrifically costly proposition when you go into especially a secondary heat proposition like coke. If you can get cheap blast furnace gas, coke oven gas, natural gas, you have got a better show if they can be used to advantage in pyrometallurgical operation.

During my past experience I had had with Bruce-Williams, we had had more experience with hydrometallurgical problems. Therefore, our leaning was that way. So all our efforts for a period of 2½ years were one of developing a chemical process. That is not particularly unique. All of the steps, all of the unit steps in it are being used in hundreds of processes today. There is nothing to be figured out actually on that. It is chemical engineering.

I have had a smattering of that, but on this last work we did we did not depend on that.

Mr. ADLERMAN. Let me ask you one question.

This process of this roasting and leaching that you have evolved, is that applicable to the Cuyuna Range ores?

Mr. STRINGHAM. Yes, sir.

Mr. ADLERMAN. And also to the Aroostook County ores?

Mr. STRINGHAM. Yes, sir.

Mr. ADLERMAN. And to the slags?

Mr. STRINGHAM. Yes, sir.

Wait a minute.

Some of the tab slags, it is not too hot on. Most of the flush slags——

Mr. ADLERMAN. Would that be an open hearth slag?

Mr. STRINGHAM. Yes, sir; but two types of slag come off that same hearth when they pull it, and they react entirely differently in your process.

Mr. ADLERMAN. Would it be good for the Aroostook ores?

Mr. STRINGHAM. Yes.

Mr. ADLERMAN. It would apply to the Virginia, Tennessee and Alabama ores?

Mr. STRINGHAM. And Arizona and Artillery Peak.

Mr. ADLERMAN. That would also apply for the Government stockpile at El Paso, Deming, Wenden, and Philipsburg?

Mr. STRINGHAM. Yes. We have big samples from all those and have worked on them.

Mr. ADLERMAN. How would it work on the Artillery Peak ores?

Mr. STRINGHAM. Perfectly easy.

Mr. ADLERMAN. It would be applicable to almost all these ores?

Mr. STRINGHAM. Yes; with different costs applied to each.

Mr. ADLERMAN. How far have you gotten on a contract?

Mr. STRINGHAM. Well, we have gotten right up to where we are going to come from third base to home if we can get that hit.

Mr. ADLERMAN. When did you put your application in?

Mr. STRINGHAM. Our application, I think, went in about last June.

Mr. ADLERMAN. Last June. And that is over 6 months ago; about 8 months ago.

Mr. STRINGHAM. It has gone a long time.

Mr. ADLERMAN. No complaint along that line?

Mr. STRINGHAM. No, sir.

Mr. ADLERMAN. What is the amount that you feel will be necessary to be spent? What will you expect by way of a contract?

Mr. STRINGHAM. $180.000.

Mr. ADLERMAN. $180,000. That seems to be a very modest amount compared to some of the others.

Mr. STRINGHAM. To break it down, there are three major categories. About $75,000 for equipment, $80,000 for equipment, 60 and 40—40 for administration and 60 for operation. That operation is supposed to be for 6 months.

Mr. ADLERMAN. I understood you to say you had done a lot of work on this over a period of years.

Mr. STRINGHAM. Yes, sir.

Mr. ADLERMAN. That was done by your corporation?

Mr. STRINGHAM. Yes, sir.

Mr. ADLERMAN. You spent your own money on it?

Mr. STRINGHAM. Yes, sir.

Mr. ADLERMAN. Did you have any of the steel companies interested on a cooperative basis with you?

Mr. STRINGHAM. No, sir; only in shipping us samples. They were very, very cooperative in that.

By the way, one thing you did not mention. I think it is mentioned in one of your reports. The Jones-Laughlin Corp. is very insistent on it. That is the dust catcher and the precipitator dust coming from the manganese blast furnaces. These dusts are quite high in manganese. They run on an average, they run an average analysis—or, rather, they took an average sample over a period of 30 days and sent that to us at our request, that they get an average sample, and it ran 26 percent manganese. You will normally say why don't they recycle that in there through a sintering process?

They do recycle some of it, but, due to the fact that they have high alkalis, potassium and sodium buildup, the more they recycle the higher the buildup and it becomes very deleterious in a furnace; those two particular chemicals get too high and the furnace chars.

Mr. ADLERMAN. Did you give us an estimate of how much you spent yourself on this process before you went to the Government?

Mr. STRINGHAM. I think Mr. Powell has some of those figures.

Mr. ADLERMAN. Could you give us a rough idea?

Mr. POWELL. I don't have any exact figures on it. It is somewhere in the neighborhood of $40,000 to $50,000 at this time.

Mr. ADLERMAN. That has been over 3 years?

Mr. POWELL. Approximately 3 years.

You understand, of course, that has been laboratory work.

Mr. STRINGHAM. Laboratory work; no salaries.

Mr. ADLERMAN. This Government contract, what does it call for? Is it building a pilot plant?

Mr. STRINGHAM. Yes, sir.

Mr. ADLERMAN. What capacity?

Mr. STRINGHAM. 300 pounds an hour.

Mr. ADLERMAN. Will that be sufficiently large to give you a good run?

Mr. STRINGHAM. Yes, sir.

Mr. ADLERMAN. How long do you think it will take you to complete your work?

Mr. STRINGHAM. Well, we have the major portion of the material spotted. Some of the material has to be tailored to fit. We figure 4½ months on construction to 5 months. Say 5 months. And a period of 6 or 8 weeks to shake down and break in and find the leaks, and this, that and the other. Then we figure from 3 to 6 months, 3 to 5 months after that that we will have the answer as far as that plant is concerned.

Mr. ADLERMAN. What does this equipment consist of that you have to put up?

Mr. STRINGHAM. It consists, first, of grinding equipment. Second is special furnace. That special furnace is not particularly special either in type, only as to materials and construction. That particular item alone runs us very close to $20,000. The rest of the material is just piping, pumps, recrystallizer, evaporator, and, as I say, they have to be out of corrosion-resistant materials.

Mr. ADLERMAN. Would you ordinarily say $80,000 for equipment for a 300-pound pilot plant was a large amount?

Mr. STRINGHAM. A lot of money.

Mr. ADLERMAN. A lot of money?

Mr. STRINGHAM. Yes, sir; too much.

Mr. ADLERMAN. Why is it necessary to spend that much. What makes it so costly?

Mr. STRINGHAM. As I say, it is the particular class of materials and construction.

Mr. ADLERMAN. It has to be tailored to measure and so forth?

Mr. STRINGHAM. Yes, sir.

Mr. ADLERMAN. And on that basis——

Mr. STRINGHAM. I might add this: On a small plant like that your instrumentation will probably be exactly the same as on a 100-ton-a-day plant. The instrumentation, as far as the plant is concerned, would be probably more than it would be on a 100-ton-a-day plant. That is a fairly good item.

Mr. ADLERMAN. In other words, whereas you spend $80,000 for a 1-ton-a-day plant, assuming it is working 8 hours——

Mr. STRINGHAM. You can't do that. That is out of the picture. It is a 24-hour deal.

Mr. ADLERMAN. You can't run 1 ton a day?

Mr. STRINGHAM. I can run 7,200 pounds a day. There is 3 tons a day.

Mr. ADLERMAN. When you go to a hundred tons, won't that be very expensive then?

Mr. STRINGHAM. Yes, it is expensive according to—well, it is not any more so than when you put up any other type of metallurgical plant, a hydrometallurgical plant. Hydrometallurgical plants are always fairly expensive. But you can't take a 300-pound-an-hour plant and extrapolate the figures on cost from that to even a 100-ton-a-day plant by any stretch of the imagination.

Mr. ADLERMAN. You say the instrumentation would be the same?

Mr. STRINGHAM. Yes, the same on a 100-ton plant as on a 3-ton-a-day plant.

Mr. ADLERMAN. Now what do you think you will be able to produce that ore for?

Mr. STRINGHAM. That is why we want to put the plant up. We have ideas, but they would be just worthless. We have looked ahead. There are too many ifs in it.

If you get good recoveries of your salts and if you get this and that——

Mr. ADLERMAN. You have to really go through your pilot plant run before you are able to say anything about costs?

Mr. STRINGHAM. I would say the thing that I would like to do——

Mr. ADLERMAN. You couldn't venture a guess right now?

Mr. STRINGHAM. It would come within $2.30 a unit.

Mr. ADLERMAN. Thank you very much.

Mr. POWELL. Excuse me. I would like to clarify 1 or 2 points if I may.

Mr. ADLERMAN. Yes.

Mr. POWELL. You said you had no complaint with reference to the progress of your contract negotiations.

Will you state for the record just what the status of the contract is at this time?

Mr. STRINGHAM. The contract has been passed through from the GSA to the Bureau of the Budget, and the Bureau of the Budget has, according to the testimony they gave the other day, they have passed the contract to be checked by the Bureau of the Budget. That is the stage right now, as they stated this morning or yesterday.

Mr. ADLERMAN. You don't anticipate any difficulty along that line, and, as far as you can tell, it is going to be through?

Mr. STRINGHAM. I don't know.

Mr. ADLERMAN. It seems to me from the testimony yesterday I think there won't be much problem on it.

Is there anything else?

Mr. POWELL. Yes.

For the record, I would like to have Mr. Stringham give us some examples of the recovery he has obtained through the use of the process in the laboratory.

Mr. STRINGHAM. Aroostook ores run from 85 percent to 87 percent recovery.

Mr. ADLERMAN. Where is your plant located?

Mr. STRINGHAM. Joplin, Mo. That is the laboratories. The slags run from 77 to 93 percent.

Mr. ADLERMAN. Recovery on slags?

Mr. STRINGHAM. Yes.

Mr. POWELL. What are the variations?

Mr. STRINGHAM. We don't know. The Bethlehem slags, tab slags, we will run about 78 percent on the tab slags and 90 percent on the

flush slags, all coming from the same furnace evidently. Youngstown slags reacted better as a total than any of them. We have an average of 87 percent recovery on the Youngstown slags. And Republic slags, flush slags from the furnaces in Cleveland, we run around 93 percent recovery. The Cuyuna Range black ores are at 97 percent. They were really a cinch.

The stockpile ores of Arizona, New Mexico and El Paso ran better than 90 percent. The wad ores of Batesville, along with the low grade, very high phosphorous material from down there, recoveries ran from 87 to 94 percent. Wad ores as a whole run better than 90 percent recovery.

That is about all. We had some ores sent from Turkey, some ores sent from Cyprus, but they are all normally psylomenic ores which are quite easy to treat.

Senator MALONE. Do you have any personal knowledge of the reserves of manganese of the various grades in the country, in these various deposits?

Mr. STRINGHAM. Just purely from the data that I have read up on. I do know of the reserves in New Mexico firsthand, that is, I have been over them. I know first hand of those in Tennessee because I got my feet wet in the manganese game down there. And I got out, too.

I know the reserves of the Batesville ore, Ozark and Amenia districts of Arkansas.

It just happens I was at the Aroostook mines when the Allied Chemical & Dye made a diamond drilling campaign on pyrites. I saw the mines. I was never in the Cuyuna Range.

Senator MALONE. In your research in addition to the percent of recovery, your research covers unit costs?

Mr. STRINGHAM. No. I was just telling these gentlemen here we have worked only from test tube work up to around 10- to 15-pound batches, bench work.

Senator MALONE. Just a matter of feasibility of separation?

Mr. STRINGHAM. Yes, sir.

Senator MALONE. Nothing on costs at all?

Mr. STRINGHAM. No, sir.

Senator MALONE. All you experienced in that line in the type of separation after determining the type of separation, do you have some background to judge what costs might be in quantity? That is, an economic-sized mill?

Mr. STRINGHAM. I am experienced as far as lead, zinc and copper are concerned. I am not experienced with reference to hydrometallurgy of manganese, and I don't think anybody else is.

Senator MALONE. Of course, some of these are new processes and, naturally, they would have to learn from experience. But experienced mining men, when they know the process that is necessary to use and percentage of recovery, sometimes have an idea then of the cost of the mill to go into production, economic size and something about the operation costs. I wouldn't want to ask the question unless your background covers it.

Mr. STRINGHAM. Talking about mining men, in other words, in cyanide work we say, "What is it going to cost you a ton to do it? That is out in your country. What is your treatment charge on a ton?"

Now I can hit that figure closer than I can hit a per-unit figure.

Senator MALONE. Of course, you wouldn't know anything about the cost of the mining until you knew something about the deposit.

Mr. STRINGHAM. I am talking about straight milling.

Senator MALONE. What should some of the costs run here per unit? Say Cuyuna ore.

Mr. STRINGHAM. About per ton of heads, we figure on about $8 a ton.

Senator MALONE. About $8 a ton. And that runs what percentage? It is a low grade?

Mr. STRINGHAM. 8 or 10 percent.

Senator MALONE. That with 97 percent recovery, what would that run? Would that be $1 to $1.25 a unit?

Mr. STRINGHAM. Something like that.

Senator MALONE. Talking about our $2.30——

Mr. STRINGHAM. We have to add a mining charge.

Senator MALONE. I was coming to that.

You would have $1 left or a little over to mine and process.

Mr. STRINGHAM. Yes, sir.

Senator MALONE. Do you know anything about the amount of the slag and the practicability of utilizing it like some of the witnesses testified yesterday?

Mr. STRINGHAM. Not in the line that they are using it. I know a little something about it.

Senator MALONE. Testimony yesterday showed that with the amount of manganese we are using now annually, about 2 million tons of 46 or 48 percent, that if this process is worked out like they thought it would if they had a 4- or 5-year program with some continuity to it, that they ought to be able to produce 50 or 60 percent of that amount from the slag eventually, not all at once, but looked forward to recovery of that much manganese.

Mr. STRINGHAM. Of course, it can be done, but your capital investment, if we leave that out of it, there are several things that go along with that process. We will take the slag you are talking about mostly.

You have got a tremendous proposition of producing enough coke for that job. It is as big a job to produce the coke as it is to get the manganese out.

Senator MALONE. There is no scarcity of coke. It would only be a matter of cost, wouldn't it?

Mr. STRINGHAM. I would expect so.

Senator MALONE. So in an important operation of this kind the cost would be the important factor. Some of the witnesses talked about a byproduct of the coke materially in reduction of costs on at least a good, substantial part of the ore.

Did you have any other information that you think would be helpful to us?

Mr. STRINGHAM. I wouldn't build too big a plant on those credits from byproducts.

Senator MALONE. I have no personal knowledge about the byproducts. We have just gotten whatever evidence we could get from the people in the work now.

Mr. STRINGHAM. I was in phosphate work, phosphorous work 13 years. To produce a 34 percent, I think, P–205 product it isn't done

every day. That was a substantial credit to that $3 figure as I understood it.

Senator MALONE. Let me ask you this.

You have had some background in mining. You have said you took your turn in the manganese business one time. To my certain knowledge, the Government has brought about the downfall of nearly all of the miners in this country with the policy they are adopting to develop the mines.

What would be necessary in the way of a principle that Congress might establish, or, if they kept away from the principle of using a duty or the tariff, as they could very well do, what length of guaranteed price, what length of time of guaranteed price would there have to be, coming one way or the other, to make it attractive to private capital to try to solve this question and put up their own money to a large extent?

Mr. STRINGHAM. Nothing under 10 years.

Senator MALONE. I introduced a bill here 3 or 4 years ago which runs out in 1958. It took care of manganese, tungsten, chromite and lesser metals, but it was not of long enough duration. Now the people that have money in it or would have money in it are wondering about renewal.

We are going to try to renew it, but, of course, before another committee. I left this committee this morning and went up to attend Senate Finance; we have a policy there, discussing a policy of whether we would renew the 1934 Trade Agreements Act which brought about virtually free trade on metals, or whether we would go back to the system of fair and reasonable competition with the fixing of a duty by the Tariff Commission.

If we went back to that method we wouldn't need to worry so much here, but if we don't we have to work something out. That is the reason we want to get the best idea we can from men who have some background in mining. That is the purpose of my question.

What would you think would be the best way of handling it?

Mr. STRINGHAM. I think it would give the men time. Any outfit will go in this if they are going to get a little return on their money, get money returned. If it was varied just a little bit—I happen to know more about the Batesville area than others.

The Batesville area is where you can get 2 or 3 different grades of ore as you mine the whole thing. You get a fairly good percentage of high-grade, high ore. This is in the little washing plant or where they have gone a little beyond the hand-picking stage. They pick up a lot of secondary metal, secondary grade that doesn't reach 34 percent or 40 percent but runs from 30 percent down to 15 percent.

If that could be purchased at a depot, we will say, located in Batesville or thereabouts, this applies to a good number of places. It applies to the Appalachians through here and in Tennessee. I know that. That is what broke me.

Senator MALONE. When were you in business down there?

Mr. STRINGHAM. 1940, 1941, 1942, 1943.

Senator MALONE. The Government always methodically breaks every miner in the business every so often through imports.

Mr. STRINGHAM. It didn't break me. It was the only thing that kept me from going broke. I discovered zinc on the property and sold it as a zinc mine.

Senator MALONE. That is the reason some of us are back here, and we have some idea of whipping that. I don't know how long it will take.

Mr. STRINGHAM. What I thought is if those ores——

They are getting quite a good deal of P–30 stuff from down there just like from out West, but if they could—it is the little fellows that develop the big ones. You never know what a little mine is going to develop into if everything is equal. So if you can get an outlet for these offgrade ores—they are not ores; they are offgrade, low-grade concentrates; put it that way—that represent a good tonnage of manganese.

We will say under the law now you can't buy those because they cannot be beneficiated up to 40 percent because in the South here mostly phosphorous, nickel, cobalt, some places zinc—those things come in. But that would put those, a lot of them, on a self-sustaining basis.

Senator MALONE. These ores could be utilized?

Mr. STRINGHAM. I am sure they could.

Senator MALONE. Now you are the first witness that has brought that up in the last two days. In Washington after 22 years it is entirely unknown that you have to have prospectors first and then small mines and then, out of maybe a few hundred prospects, you get maybe 3 or 4 dozen producers, and out of a hundred producers you might get 1 pretty good mine. No one in Washington knows that. They just look there and if there is no mine in sight, then they just take it for granted we can't produce anything.

Now what would you say, either method being used, say a 10- or 15-year guarantee of price on the basis of my bill originally, which you are familiar with, I am sure——

Mr. STRINGHAM. Yes.

Senator MALONE. Or revert to the principle of protection on the basis of fair and reasonable competition, equalizing wages and taxes here and in the chief competitive country on each mineral—manganese in particular—but in some way would either principle grant a unit price? Where do you think we might land in 5 or 6 or 7 years in the production, in the amount of production annually in going-concern mining enterprises in manganese?

Mr. STRINGHAM. I certainly agree with 2 or 3 of the gentlemen who gave testimony yesterday and the day before and this morning, that you can reach 50 percent, and when you get 50 percent it is easy to get 60.

Senator MALONE. Then if we reach 60 percent of our needs and have a going-concern, day-after-day, year-after-year mining enterprise, profitable concerns, then if we had a sudden emergency it is not too hard to increase materially the output, is it?

Mr. STRINGHAM. No, sir.

Senator MALONE. In a reasonable time?

Mr. STRINGHAM. That is right.

Senator MALONE. It is hard to do that when you have no going-concern mines. Is that right?

Mr. STRINGHAM. Yes, sir.

Senator MALONE. That agrees substantially with what I have long contended, that for private money to go into anything there has to be at least a guarantee through an amortization period.

Do you have any other information that you think will be helpful to us that you want to offer at this time?

Mr. STRINGHAM. No.

I was just kind of shooting off on my own thing first, trying to help all I can.

Senator MALONE. That is very helpful.

Your testimony will be returned to you for correction, and feel free to enlarge on it or inject anything new you think would be helpful. You have heard the questions here for 2 or 3 days and you know what we are trying to do.

I would like to see a going-concern mining industry in manganese as well as these other metals.

What do we have to do to get it? Give it some thought and round out your testimony for us. Will you do that?

Mr. STRINGHAM. Yes, sir.

STATEMENT OF FRANKLIN C. SALISBURY, WASHINGTON, D. C., ACCOMPANIED BY GEORGE SYLVESTER, SYLVESTOR & CO.

Mr. SALISBURY. My name is Franklin S. Salisbury, 1624 I Street, Washington, D. C.

Also appearing at this time is Mr. George Sylvester of Sylvester & Co. Mr. Sylvester testified yesterday but is available to answer questions today.

I am a graduate of Yale University, Western Reserve University Law School, and attended Georgetown Law School; I was Chief of the Legal Branch of the Safety and Security activities of the office, Chief of Ordnance during the last war. I am now a member of the internal security committee of the bar association here in Washington. I was also chief of the legal division of the Foreign Liquidation Commissioner's Office in Rio de Janeiro, Brazil, during the latter part of World War II.

At the suggestion of certain governmental agencies, we set up a nonprofit research corporation, Strategic Research, Inc., to further the investigations into manganese recovery problems. Mr. Sylvester is a member of the board of that company, and I serve as its president.

The purpose of our testimony today is to assist this committee in framing a program which will provide equal opportunity for all interested persons to contribute to a prompt solution of the problem of providing a domestic source of metallurgical grade ferromanganese.

The need for such a program is shown by the difficulties in obtaining manganese for the use of the steel industry during wartime, under wartime conditions.

The Senator will remember that perhaps the first 60 ships sunk by the Germans in the Caribbean area during the last war were manganese-carrying ships. They picked them off. The Russians were our primary source of high-grade manganese, and for 1 of 2 reasons the Soviet Communists cut us off, either because their timetable for starting a third world war was off or they were running out of manganese themselves.

Senator MALONE. I think the Russians are smart and they are for Russia. They do not intend to help the people that they might have to fight. We are the only Nation that does that. We give them money and materials to fight us with and get ready so it will be a good fight,

I guess. We did that with Japan and are doing it now with Russia.

Mr. SALISBURY. As we all know, the Russian scientists are proving to be exceptionally good in research and development. They are perhaps weaker than our scientists in the engineering phases of their operations.

Senator MALONE. Don't they have a large number of German engineers in Russia? Didn't they get a good sample of the German engineers right after World War II?

Mr. SALISBURY. They did, sir.

Senator MALONE. No one ever said the German engineer didn't know what he was doing.

Mr. SALISBURY. No, and it is being proved today. I understand that in the chemical abstracts that are being published a great many are from Russian sources and that we use them today in our Government work and also in our private industry.

Now the first question that would come to a person's mind in framing a program for the recovery of the manganese wasted in steel making is: Why not go to the steel industry and have them do it. They are the primary users of the manganese which is mined and made into ferromanganese.

The answer to that question is quite obvious.

The steel industry no more feels obligated to work on this particular raw material than the automobile industry does. After all the automobile makers, too, use the steel which required the ferromanganese.

You might as well go to the Ford Motor Co., and say, "You should work on the manganese problem. There is a lot of manganese in your car."

The answer you get—I have already done this—is "We have other things more immediate to our problem. That is a Government problem."

During the work we have done on behalf of Strategic Research, Inc., and the Sylvester process we have had many occasions to contact the steel companies to get their support or at least determine why their support was not available. Their support is not available because they do not feel it is their problem. They say "This is a security problem. The need for manganese is a military problem. Go see the Government."

We have been before the Government and industry now for 5 straight years to get support for the Sylvester process for recovering manganese from open-hearth slags and low-grade manganese ores. I would like to present for the record a letter from the Jones & Laughlin Steel Corp., which gives an example of the attitude of the steel industry towards our efforts to free them from their deadly reliance on off-shore manganese ores. I will quote:

> On May 29 you wrote Adm. Ben Moreell about a process you are interested in for the recovery of manganese from open-hearth slag.
>
> We will be unable to consider any commitment of this kind for the next 5 years, at which time this whole possibility will be further developed. We might be glad to get in touch with you again if the process you have in mind has been developed to a commercial stage.

Senator MALONE. It will be accepted and made a part of your testimony at this point in the record.

(The letter referred to follows:)

JONES & LAUGHLIN STEEL CORP.,
Pittsburgh 30, Pa., June 10, 1953.

Mr. FRANKLIN C. SALISBURY,
Washington 6, D. C.

DEAR MR. SALISBURY: On May 29 you wrote Adm. Ben Moreell about a process you are interested in for the recovery of manganese from open-hearth slag.

We will be unable to consider any commitment of this kind for the next 5 years, at which time this whole possibility will be further developed. We might be glad to get in touch with you again if the process you have in mind has been developed to a commercial stage.

Sincerely,

V. H. LAWRENCE,
Vice President, Planning and Control.

Mr. SALISBURY. In connection with the presentation of any program of research and development to the Government, it is always advisable for the person undertaking that task to obtain an analysis from independent sources rather than from the client himself, who is naturally biased in favor of his own proposal. I undertook to obtain the services of an engineer, Dr. Richard S. Cole, who was formerly with the Bureau of Mines. He has been employed in the past by the Sharon Steel Co., the Boston Navy Yard, Southern Ferro Alloy Co., and from June 1948 through July 1953 he was Chief of the Iron and Steel Division, Office of Materials Specialists of the Munitions Board. I, therefore, obtained from him an independent review and analysis of this proposed Sylvester process, and would like to offer that for the record.

Senator MALONE. It is accepted and made part of your testimony at this time.

(The document referred to follows:)

REVIEW AND ANALYSIS—ECONOMIC AND TECHNICAL REPORT SUBMITTED ON BEHALF OF THE PROPOSED PRODUCTION OF FERROMANGANESE FROM WASTE STEEL MILL SLAGS AND AROOSTOOK COUNTY ORES BY THE SYLVESTER PROCESS

From Dr. Richard S. Cole, Silver Spring, Md., August 1, 1953

ENGINEERING REVIEW AND ANALYSIS—SYLVESTER PROCESS

Introduction

The undersigned, Dr. Richard S. Cole, has been retained by Franklin C. Salisbury to study information made available by Sylvester & Co. of Cleveland, Ohio, in connection with the exploitation of their patent (U. S. Patent No. 2,539,485) for the recovery of manganese and iron from waste steel mill slag. Dr. Richard S. Cole has no official connection with Sylvester & Co., and has been retained as an independent adviser by Franklin C. Salisbury in order to give an independent evaluation of the economic and technical bases of the Sylvester process for the recovery of manganese and iron from slag.

Qualifications of Dr. Richard S. Cole

For the past 10 years Dr. Cole has done consulting work, both in the United States and Europe, for the Great Lakes Carbon Co., Pittsburgh Metallurgical Co., Chemmetals Corp., Swiss American Bank and Southern Ferro Alloy Co. His educational background is as follows: Bachelor of Science degree (1922–1926) from Colorado University, a Master of Science degree (1926–1928) from Carnegie Tech and a Ph. D. (1930–1933) from the University of Pittsburgh, all in metallurgical engineering.

From June 1928 to February 1935 he was melting superintendent at the Braeburn Alloy Steel Corp. where he supervised electric furnace production of carbon and alloy steel, die steel, high-speed steel and heat and corrosion resistant alloys.

From February 1935 to September 1940 he was chief metallurgist at the Sharon Steel Corp. where he supervised technical control and practice on blast furnace,

open hearth and electric furnaces, and rolling mills producing carbon and alloy steel.

From September 1940 to October 1943 he was employed as master melter at the Boston Navy Yard where he supervised the melting and casting of alloy iron and steel for casting and forging ingots. The equipment which he used included electric and induction furnaces, Bessemer converters, and cupolas.

From October 1943 to March 1948 he was employed as a research metallurgist by the United States Bureau of Mines at Norris, Tenn. and Raleigh and Salisbury, N. C. At the Bureau of Mines he designed, built and operated a pilot plant for smelting of low and marginal grade ores, including bauxite, ilmenite, magnetite, manganese and high nickel iron ore. This work covered the evolution of new methods and the improving of existing methods of smelting ores. He worked on modifications of the Pedersen process for extracting alumina from clay and low-grade bauxite, and the Krupp Renn process for smelting iron, nickel and chrome ore. He did research and development work on a method of smelting iron and manganese ore similar to the recently announced Arate process and modification of the Hoganes process for producing sponge iron.

From September 1947 to March 1948 he was employed as chief metallurgist of the Southern Ferro Alloy Co. of Chattanooga, Tenn. where he supervised the production and quality control on 6 electric furnaces and 2 blast furnaces producing ferro-silicon and ferro-manganese and charcoal pig iron.

From June 1948 through July 1953 he was chief of the Iron and Steel Division, Office of Materials Specialists of the Munitions Board in Washington. With the Munitions Board he was the principal staff member on problems relating to metals and alloys where he investigated technical and economic data and prepared studies on the availability, production facilities and methods, geographic distribution and strategic importance of iron and steel, ferro-alloys, and other related materials required in the production of military equipment. He represented the Munitions Board on industrial and inter-agency committees concerned with problems related to these materials. He investigated and reported on new processes for the extraction, melting shaping and use of metals and alloys, especially for high-temperature applications.

Background and qualifications of Robert Schoenlaub, director of research, Sylvester & Co.

The undersigned, Richard S. Cole, consulting engineer, is acquainted with the inventor of the Sylvester process for the recovery of manganese from slag and endorses him as a qualified research scientist. From 1930 to 1933 Dr. Schoenlaub was graduate assistant, department of mineralogy, Ohio State University, Columbus, Ohio, where he assisted in descriptive mineralogy, microscopic mineralogy, crystallography, and X-ray diffraction. Subsequently from 1933 to 1936 he was with the State Highway Testing Laboratory, Columbus, Ohio, where he did laboratory and field work on road mixes, concrete, etc.

From 1937 to 1940, he was employed by the Owens-Corning Fiberglas Corp., Newark, Ohio, solving problems in the manufacture of fiberglas and in the development of a glass composition which is now used by all fiberglas manufacturers.

From 1940–45 he was manager and director of research for Basic Refractories, Inc., Cleveland, Ohio, where his duties comprised the organization, supervision and instigation of control, research and development for magnesia and dolomite refractories.

From 1945 to the present time he has been research director of Sylvester & Co. in Cleveland, Ohio, where he has spent all of his time on the extractive metallurgy of zirconium, beryllium, manganese and magnesium oxides.

From information supplied by Sylvester & Co. it appears that Dr. Schoenlaub has been granted the following patents:

1937–40:

Glass Composition, 2, 334,961

1940–45:

Colored Glass Fibers, 2,394,493
Magnesia Containing Refractories, 2,364,002
Plastic Bonding Basic Refractories, 2,406,909
Treatment of Refractory Materials, 2,406,910
Refractory Lining of Metallurgical Structures, 2,402,725
Working Up Refractory Magnesia Containing Rock, 2,414,980
Separation of Magnesium Carbonate from Calcium Carbonate, 2,433,297
Working Up Magnesia Rock and Purification of Magnesium Carbonate,

1945:

Recovery of Manganese From Compound Silicate Material, 2,539,485
Recovery of Metallic Oxides such as Zirconia, 2,578,748
Recovering Magnesia, 2,578,657
Hermetically Sealed Insulator Bushing Assembly, 2,591,205

Dr. Schoenlaub was educated at Ohio State University where he received his B. A., M. S. and Ph. D. degrees.

Qualifications of Sylvester & Co.

The economic and technical data which the undersigned, Dr. Richard S. Cole has studied, in preparing this report was prepared by Sylvester & Co. of Cleveland. The Sylvester & Co. organization has two departments. One department is primarily concerned with the design and construction of specialized custom built industrial furnaces and allied automatic equipment for the chemical, metallurgical and ceramic industries. The second departments is engaged in fundamental research, the majority of which falls within the fields of extractive metallurgy or thermo-chemical mineralogy or a combination of both. Their research department has, during the past 8 years, made several major discoveries in the field of extractive metallurgy and many minor developments in the field of new structural bodies formed of materials such as stabilized zirconium oxide.

A new method for the separation of beryllium oxide from beryl ore has been discovered by Sylvester & Co. In addition they have developed a process for the extraction of pure crystalline completely stabilized zirconium oxide from zircon sand. They have discovered a process for commercial separation of pure magnesium oxide from dolomite. Commercial plants are now under construction for the beryllium and zirconium processes.

From study of information supplied by Sylvester & Co. and acquaintance with its personnel, the undersigned believes them to be a highly qualified research and development firm in the field of extractive metallurgy.

Review and analysis:

Based upon personal observation of the pilot plant work conducted at the College Park Station of the United States Bureau of Mines by Dr. R. A. Schoenlaub under the general supervision of Paul M. Ambrose, Chief of the Minerals Technology Division and under the general guidance of John E. Conley, Chief of the Minerals Processing Branch of Region VIII of the United States Bureau of Mines, and many years of research and operating experience in the production of ferro-manganese and other ferro alloys, I am convinced that the Sylvester process for the recovery of manganese and iron from open hearth slags can be economically feasible and that the technical feasibility of the process is an established fact.

I have studied the information submitted by Ohio Manganese, Inc., in their brochure entitled "An Economic Report of the Proposed Production of Ferro-Manganese from Waste Steel Mill Slags," dated November 21, 1952. This material was prepared by Dr. Robert Schoenlaub, Mr. George Sylvester and Mr. D. W. Lloyd, who has been for several years general superintendent of operations at the Brier Hill Works of Youngstown Sheet & Tube Co. in Youngstown, Ohio. The operating cost statements of the process have been developed by Mr. Sylvester and Mr. Lloyd from practical experience and published data on the various unit operations. The figures are conservative and I feel that they are quite accurate and adequate.

I have also studied the report of the Bureau of Mines, which fully describes the results of pilot plant operations where the technical feasibility of recovery of chemically combined manganese and iron from open hearth slags was proved. This work is reported in Bureau of Mines Report of Investigations, No. 4847, entitled "Manganese Concentrates From Open-Hearth Slags by Lime-Clinkering (Sylvester) Process" by John A. Ruppert, dated February 1952. This pilot plant work was done at the United States Bureau of Mines (College Park Experimental Station) under the general supervision of Paul M. Ambrose, Chief of the Minerals Technology Division, and under the guidance of John E. Conley, Chief of the Minerals Processing Branch of Region VIII of the Bureau. I was an official observer of this pilot plant operation, for at the time I was assigned to report on this development project to the Munitions Board of the United States Government. I, therefore, have relied to a considerable extent in preparing this evaluation on the work done at the Bureau of Mines and their published reports.

In addition to the technical data supplied by Ohio Manganese, Inc., and the published report of the Bureau of Mines, I have studied the Report by the Manganese Panel of the Metallurgical Advisory Board of the National Academy of Sciences (Report MAB–10–M, dated December 21, 1951) entitled "Production of Manganese from Domestic Sources." This report indicates that the Sylvester process plus ammonium carbamate leaching of the Sylvester concentrate is considered technically feasible for open hearth slags and domestic ores.

These various studies and my own personal work both at the Bureau of Mines and in private industry convince me that the Sylvester process is both technically and economically feasible.

The process is primarily designed to recover both manganese and iron from silicate materials. A number of different methods can be used if the iron and manganese are in the oxide form; however, the complex silicates present an entirely different problem and it is this problem which is involved in recovering the manganese from open hearth furnace slags.

The basis of the Sylvester process is the formation, by suitable heat treatment, of compounds called ferrites, which are magnetic. Ferrites are formed by the combination of ferrous oxide (Fe_2O_3) with certain metallic monoxides, such as FeO, MnO, MgO, NiO, etc., to form magnetic compounds such as Fe_3O_4, ($Fe_2O_3+FeO=Fe_3O_4$). Fe_2MnO_4, Fe_2MgO_4, and Fe_2NiO_4, Mn_2FeO_4, $MgMnFeO_4$ which, by virtue of their magnetism can be freed from any associated material in a magnetic separator. Concentrates from the magnetic separator containing a minimum of 50 percent metallics (iron plus manganese) can be smelted in either an electric furnace or a blast furnace to produce spiegel, or can be treated by selective reduction in an electric furnace to produce a high manganese pig iron and standard ferromanganese.

This process can be broken down into three major operations. The first is one of slag preparation in which the raw material is prepared and blended for later conversion from silicates to oxides. The second stage is that of conversion from silicate minerals to oxide crystals. The third stage concerns the reduction of the iron and manganese oxides to metallic products such as pig iron, ferromanganese and spiegeleisen.

Slag, as received from the steel mill is in the form of large lumps which in themselves contain 4 to 5 percent of metallic steel as inclusions. In addition, the slag analysis varies from day to day depending upon the type of steel being made in the furnaces. In order to eliminate very tedious daily analytical work to determine the amount of correcting limestone which must be added, the slag will first be crushed and then blended in such a manner that the analysis will be relatively uniform. Each day's production of slag will be distributed by continuous conveyors in thin layers to form a 10,000-ton pile of material. A previously formed pile of material will be excavated from the end, thus gathering a small amount of each of many day's production. This average slag is then sent to the processing plant for further treatment. In order to recover the metallic steel inclusions, magnetic pulleys are used after each crushing operation. The purpose of this is twofold, first the metal has value when returned to the steel mill, and second, grinding is improved because the malleable parts of the slag are eliminated.

The second step of the process is designed to change the mineralogical constitution of the slag, and to separate the products in order to discard the waste portion containing the undesirable phosphorus. This elimination of phosphorus is very essential since our entire steel mill practice is designed to remove phosphorus contained in the original one. Thus products such as ferromanganese or spiegeleisen containing more than very small quantities of phosphorus are not acceptable to our industry.

In the second step, sufficient limestone is added to the original slag to correct its composition to one capable of forming an iron manganese containing magnetite, dicalcium silicate, and tricalcium phosphate.

After the limestone is added to the slag, both materials are ground in a continuous ball mill to a particle size approximating one-sixtieth of an inch (0.017 inch). At this point, one-half percent or less of fluorspar is added to broaden the softening point of the mixture when it is heated.

The three materials, slag, limestone, and fluorspar, are then processed in a continuous rotary kiln where they are heated to approximately 1,350° C. At this temperature the material will clinker and form balls but will not melt. After meing heated, the clinker is quenched in water and ground wet to approximately 50-micron size particles.

The heating operation forms a new mineral system when the composition of the slag is properly balanced with limestone. The new crystals which are formed are, for all practical purposes, dicalcium silicate with tricalcium phosphate in solid solution, and magnetite of a complex formula. The magnetite crystals will contain manganese, iron and magnesium, all oxidized in the typical magnetic formula. The formula can take any of several forms such as $MgO.Fe_2O_3$, $MnO.Fe_2O_3$, $FeO.Mn_2O_3$ or $MgO.Mn_2O_3$. This magnetic material is extremely magnetic and compares in every respect with the classical Fe_3O_4. The dicalcium silicate and tricalcium phosphate crystal is completely nonmagnetic. The amount of manganese contained in the magnetite crystal seems to have no bearing on the magnetic quantities of the material. In other words, this oxide crystal behaves magnetically in an entirely different fashion from mixtures of metallic iron and metallic manganese.

After clinkering and quenching the finely ground material which has been processed through wet ball mills, it is passed over magnetic separators of the drum type. This type of equipment is extensively used in the separation of magnetic taconites from silica rock. In this operation the material is likewise ground to approximately 40 or 50 microns in size. The third step converts the concentrate to metal. The magnetic concentrate can then be converted to metal in any one of several ways. It will normally contain 50 to 65 percent metallics so that it can be smelted in electrical furnaces, blast furnaces or other suitable reduction unit.

The average open hearth steel mill slag will contain about 8 percent manganese and 20 percent iron or a ratio of 1 to 2½. The concentrate will contain the same ratio of manganese to iron but the concentrate will be enriched to a point where the iron and manganese will total more than 50 percent with the elimination of calcium silica and phosphorus. Approximately 80 percent of the iron and manganese contained in the original slag can thus be recovered.

The broad principles of the Sylvester patent were proved by the work done at the Bureau of Mines. I have studied the letter prepared by Dr. James A. Boyd, Director of the Bureau of Mines, dated March 16, 1951, in which he stated that the Bureau of Mines was in agreement with the following conclusions from its pilot plant work on the Sylvester process:

1. The mixture of slag and limestone can be heated in a rotary kiln to produce a reaction in which two distinct crystal substances are formed.
2. The first crystal substance contains substantially all of the manganese and iron in the oxide form together with oxides of magnesium and aluminum, while the second crystal substance contains substantially all of the calcium and phosphorus in the silicate form.
3. The two crystal substances can be ground and separated magnetically.
4. The recovery of manganese in Bureau of Mines equipment approximate 80 percent.
5. The phosphorus content of the magnetic concentrate was reduced to about one-fifteenth of the amount contained in the original slag by the process as demonstrated in the Bureau of Mines equipment.

It is my personal opinion that the pilot plant work showed conclusively that the methods proposed will work successfully and at high efficiency. There is no doubt that operating costs will be low because the processes involved are presently in use on a large scale in other industries such as the portland cement and taconite concentrating fields. Overall estimates of costs show that approximately 80 percent of the manganese can be recovered in the form of ferromanganese at a price of approximately $150 to $175 per ton when the credit for pig iron is considered. There is no waste material from the process. The original tailings can be used as agriculture liming material and this has been shown by the Agricultural Department of our Government. The residual slags being free of phosphorus can be recharged in the average steel mill blast furnace. The two materials which are produced, namely pig iron and ferromanganese, are, of course, in wide demand.

There are several points concerning the Sylvester process which I would like to emphasize. The process can recover in the concentrate form, 75 percent to 85 percent of the manganese and iron contained in the original slag. Either flush slag or common mixtures of flush tap slag can be used. The phosphorous content of the concentrate can be reduced to less than .01 percent if such is desired. In fact, the phosphorus can be reduced to practically zero with simple extra processing equipment. The metallic content of the concentrate will approximate 50 percent. If slags low in magnesia are used, the metallic content will be even higher. Ratios of iron to manganese will be determined by the ratio of the

original slag. The cost of producing the concentrate will approximate $5 per ton of slag processed, or $10 per ton of concentrate regardless of the manganese content.

The magnetic concentrate can be used in many different ways. Some examples are as follows:

(*a*) In the briquetted form the concentrate can be fed to a steel mill blast furnace to produce a higher manganese content in the hot metal.

(*b*) The briquetted concentrate can be added directly to the open hearth although the manganese efficiency will be low. Still, by using this process, a high circulating load of manganese will not be costly to process. The residual manganese in the open-hearth product can help reduce the additions which are required.

(*c*) The concentrate can be directly smelted by any suitable type of furnace directly to spiegeleisen. The ratio of iron to manganese in the spiegel will be the same as that in the original slag. Usually this will produce a spiegel containing roughly 30 percent manganese.

(*d*) The concentrate can be used as an auxiliary feed by present ferromanganese producing furnaces.

(*e*) The concentrate can be reduced by two steps to low phosphorus pig iron and standard ferromanganese. The pig iron may be sold in the open market or may be used as an addition to the steel mill hot metal. The manganese slag may be used to make any grade of ferromanganese or it may be mixed with low grade ore to produce ferromanganese.

(*f*) The concentrate may be chemically treated or leached if such treatment is economically practical to produce iron and manganese products.

The process does not require enormous capital investment such as is needed for blast furnace and coke oven plants. Approximately 5 complete processing plants can be constructed for the cost of 1 blast furnace.

From the economic standpoint the process is sound because it embodies no radical or unproven steps. The formation of ferrites by treatment in a rotary kiln, the magnetic separation, and the reduction with carbon are all standard practice in other commercial operations. Dr. Schoenlaub's originality consists of combining these standard procedures and applying them to the recovery of strategic materials from a waste product.

It naturally follows that, since all technical factors in the process are standardized and accepted commercial operations, the required equipment is also standard and practically available "off the shelf" from recognized producers. Nothing of new or radical design is required; consequently, capital and operating cost can be calculated with a minimum of error. In determining the economic feasibility, I have checked the economic data prepared by D. W. Lloyd of Youngstown Sheet & Tube Co. and George Sylvester of Sylvester & Co. as submitted in the before-mentioned Economic Report of the Proposed Production of Ferro-Manganese From Waste Steel Mill Slags prepared for Ohio Manganese, Inc., and dated November 21, 1950.

Metallurgists have worked for many years on various methods of manganese recovery without too great a degree of success. Primarily, the reason for this is because they have worked along chemical lines rather than along ore-dressing or mineralogical ones. Chemical methods are not conducive to low costs, particularly when expensive reagents are used, and stainless steel or other special equipment is needed to handle the processing steps. The Sylvester process is the first one to utilize cheap methods, such as are commonly used in the portland cement and ore-dressing fields. It is because of these methods that I believe the Sylvester costs are competitive with imported natural ores, even at prices somewhat lower than today's market quotations.

For some time I have been actively interested in studying the other processes which are being offered for the recovery of manganese from open-hearth slags. The United States Department of Interior has published a volume on Manganese as part of the materials survey series under the sponsorship of the National Security Resources Board. It lists no processes for the recovery of manganese from open-hearth slags but does discuss the so-called Pittsburgh process of the Bureau of Mines. This Bureau of Mines method was actually discovered and patented in 1939 but was abandoned because it could not compete economically with conventional methods of extracting ferromanganese from foreign ore. The work was originally done by Dr. Royster of the Bureau of Mines in the small Interlake blast furnace at Toledo. The process was revived by the Bureau of Mines and American Iron and Steel Institute. Even assuming equal operating costs for both processes, the capital cost of erecting and operating a blast fur-

nace and converter plant as required by the Pittsburgh process would involve many times the capital cost of the equipment required by the Sylvester process for a plant of equal capacity.

The Bureau of Mines has stated that their manganese-reducing blast furnace requires a blast temperature of approximately 2,400° F. which is about 1,000° higher than is standard practice on a conventional blast furnace making ferromanganese. This will require, in addition to supergrade refractories, specialized equipment for heating a blast to so high a temperature.

In addition to the fact that a market is practically assured for pig iron and ferromanganese, the Sylvester process is attractive economically because the principal raw material, open-hearth slag, is obtainable at relatively low cost. Many steel plants are paying as much as 50 cents a ton to dispose of their slag. In the production of ferromanganese, ore is by far the largest individual cost item per ton of alloy produced. Ore cost accounts for a minimum of 75 percent of the total manufacturing cost per ton of alloy. Ore cost covers mining, milling, and transportation. In the Sylvester process there will obviously be no mining or transportation cost. Firing in the rotary kiln including the required crushing and grinding, magnetic separation, and the first furnacing operation will be comparable to conventional milling costs with one important difference: The first furnacing operation will produce a salable product—pig iron—credit for which will more than balance the cost of treatment.

According to Sylvester & Co.'s estimates, which do not appear unreasonable, the operating cost of a recovery plant show that 1 ton of ferromanganese could be produced for $93 if a credit of $130 is allowed for the pig iron recovered with the manganese. In other words, 13½ tons of slag will produce 1 ton of ferromanganese with a sales value of $225 and 2.4 tons of pig iron with a sales value of $130, at a cost of $223. To explain further, total sales from 13½ tons of slag will amount to $355, while operating costs will total $223. If all of the operating costs were charged against the ferromanganese, there would be no profit on that material; but there would be a profit of approximately $130 on the pig iron.

From the above, it may readily be seen that the recoverable iron and very cheap raw material make the process economically feasible. Fortunately, there is a tremendous and continuing demand for both ferromanganese and pig iron. As our domestic iron ore supplies are further depleted, the demand and price for pig iron will undoubtedly increase.

In conclusion, based upon my personal observations of the pilot plant work, study of the economic and technical data supplied by Ohio Manganese, Inc., and others as mentioned above, I believe the Sylvester process for the recovery of manganese and iron from open-hearth slags is technically sound and can be economically pursued by Ohio Manganese, Inc., in the Youngstown, Ohio, area.

Respectfully submitted.

RICHARD S. COLE.

DISTRICT OF COLUMBIA,
City of Washington, ss:

Richard S. Cole, being duly sworn, deposes and says that he is a qualified and experienced metallurgist, having received his B. S. from Colorado University, his M. S. from Carnegie Tech, and his Ph. D. from the University of Pittsburgh in metallurgical engineering; that he has been retained by Franklin C. Salisbury for the purpose of reviewing and evaluating economic and technical data submitted by Sylvester & Co. for the purpose of preparing this engineering report; that the attached report is true of his own knowledge except as to statements of information and belief, and as to such believes them to be true.

RICHARD S. COLE.

Subscribed and sworn to before me this 1st day of August 1953.

[SEAL] MARIANNA D. WAGGAMAN,
Notary Public.

My commission expires April 14, 1957.

Mr. SALISBURY. The first place where a person having a technical process in connection with manganese goes in Government is to the Bureau of Mines. That is an old-line Government organization which, in addition to its mine safety functions, has several small research divisions. One such research division developed manganese

recovery processes of its own. In addition, it will consider other outside projects. Mr. Sylvester came down to Washington some 5 years ago and saw the Secretary of the Interior—who I think was Oscar Chapman at the time—to obtain a contract with the Bureau of Mines for what is known as a cooperative project, to operate a pilot plant to prove the general principles of the Sylvester process. This work was carried on actively for 9 months and inactively for a year.

The Bureau of Mines finished its work and published a report which is entitled "Manganese Concentrates From Open Hearth Slags by Lime-Clinkering (Sylvester) process," by John A. Ruppert—Report of Investigations 4847—July 1951.

The report reveals in the Summary and Conclusions, which opens the report, that the purpose of the tests had been successfully carried out and states:

> These broad principles have been substantiated by numerous clinkering operations made in an electrically fired studio-type kiln, a batch rotary kiln, and a continuous rotary kiln and by magnetic separations made in a Davis tube separator and a laboratory-size Jeffrey-Steffensen three-roll continuous separator.

There are many pages of scientific data which I would like to offer for the record.

Senator MALONE. It will be accepted as exhibit 1 in your testimony; not a part of the written record but as exhibit 1.

(The document referred to above was maked "exhibit 1," and is to be found in the committee files.)

Mr. SALISBURY. We had the unfortunate experience of finding the Bureau of Mines, in its ambitions to help in the solution of the manganese recovery and domestic low-grade-ore problems, becoming a competitor of the other independent interests who were also trying to solve the problem by methods developed in their own privately financed laboratories.

I recommend that in connection with any legislation on this subject steps be taken to avoid the anomalous position of having the Bureau of Mines actually competing for available private capital to support research and development projects as happened in the Manga-Slag promotion, because the human result of such a situation is to have the Bureau of Mines personnel favor their own projects over those of non-Bureau inventors.

We have run up against that attitude time and time again in this particular case.

Senator MALONE. Generally speaking, don't they carry on the research until they think the process is feasible, and then the process is made available and they generally slowly fade out of the picture, don't they? Isn't that the general custom?

Mr. SALISBURY. No more than General MacArthur faded out.

Senator MALONE. I wish he were the head of the national defense, myself.

Mr. SALISBURY. There are two types of proposals for new processes and methods: those which the Bureau of Mines invents inself and those which outside industry invents.

Senator MALONE. Now in the titanium process they perfected the Kroll process and then discontinued the operation in Boulder City. They were carrying that out and perfected it to the point it could be used, and now it is being used, and by private industry, and they have quit.

Mr. SALISBURY. It is different in the manganese field because many of these processes have been developed by private industry and brought to the attention of the Bureau of Mines by other Government agencies. I think you will find that the Bureau of Mines has had a tendency to hold those projects up rather than to help them.

I talked to many of the people who have been testifying before this committee, and find that it is unanimously their opinion that that is what is happening.

Senator MALONE. You heard testimony yesterday. Or were you here yesterday?

Mr. SALISBURY. Yes, sir.

Senator MALONE. Or perhaps it was the day before. But you were here when Dr. Ralston was here. We asked him to spearhead an estimate over there as to what it would be, what would be necessary for them to have to carry through research for 4 or 5 years to reach some logical conclusion on some of these ores—the slags and the Cuyuna Range. If they carried this through, would that interfere with private organizations?

Mr. SALISBURY. There would be a definite interference if the money was made available to the Bureau of Mines exclusively as a research agency itself to do the work itself.

There would be no interference, obviously, if the money were made available to the Bureau of Mines or the Emergency Procurement Service or some Government agency to allocate to private contractors to undertake Government-sponsored independent research and development.

Senator MALONE. Do you mean the contract with them to do the job?

Mr. SALISBURY. Yes, the same as is done by the Office of Naval Research or the Atomic Energy Commission. You don't give money for research to the old line Agency and say "Here is 5 years and 5 million." If you do, they will work for you for 5 years for $5 million and they will be back for $10 million for 10 more years.

If you gave them $30 million you could keep them going for 30 years, and that is what you have done already.

Senator MALONE. I don't think we have kept them going 30 years, but they make a spurt at every war, and then they quit.

Mr. SALISBURY. The spurt comes from the outside persons who become interested, due to the critical nature of the problem, and bring the problem to the attention of the Bureau of Mines.

Senator MALONE. Congress gets scared during the war and they appropriate money and they will "never let it happen again", but then they quit.

Mr. SALISBURY. If you make available a fund of $10 million, say, for 8 to 10 years, to be given to a Government agency for participation by the Bureau of Mines, competitively with any other private research agency, you would have a complete solution of the problem that you are interested in.

Senator MALONE. In 10 years?

Mr. SALISBURY. Easily.

Senator MALONE. Five?

Mr. SALISBURY. I don't want to say 5 years because many times it is a very difficult thing to even build these plants.

Mr. SYLVESTER. Mr. Chairman, I have had lots of experience in management of research personnel, and there is a tendency in both pri-

vate research departments and public research departments to carry on research for research's sake. No scientist worth his salt is ever satisfied with results he has gotten. He expects to get better results and still better results, and it is the function oftentimes of management in business to bring the research work, pure research work, to a halt and start development work.

I believe, in my reading, in review of manganese over a fairly lengthy period of years, that we are carrying on research for research's sake where we ought to be carrying on to the end point.

We have to stop research someplace and go to development, to trials, of large-scale operations.

Senator MALONE. You heard the last witness, Mr. Stringham, and we were talking when we had Dr. Ralston on the stand, questioning him, and asking for an estimate of the cost of the 5-year period, and asking him about definite processes like, for example, the slags. We know they are going to do some of the work on the slags. We are informed it is not ready yet.

We asked him particularly about the Cayuna Range because everyone agrees that probably contains the largest amount of low-grade ore of any known deposit.

Now, do you think that research for research's sake, if you put them right on those two particular projects and ask for the results——

Mr. SYLVESTER. I believe there are several processes today that are capable of expansion. I don't say they are perfect. I think none of us has an idea of when a period of emergency might arise. We don't know how valuable time might be, but I think we would be far closer to the solution of this problem 1 year hence or 2 years hence or 5 years hence, if more strenuous efforts were made to build larger scale units. Maybe some of them would be thrown away, maybe they would be uneconomical. There is a possibility they might survive by Government subsidy. They might survive by guaranteed prices. They might survive by a tariff on imported manganese ore. Or the possibility exists that they might survive in competition with worldwide conditions today. But we are not going to find that out on a small laboratory scale, we are only going to find it out on a fairly large plant scale.

Senator MALONE. Do you think there are processes now at a proper stage on the slag production of manganese, production of manganese from slag, to build a production plant?

Mr. SYLVESTER. Yes, sir.

Senator MALONE. What size would you build, approximately?

Mr. SYLVESTER. If the money were available, I would suggest a full-scale prototype plant capable of handling slags or ores at the rate of at least 200 tons a day.

Senator MALONE. Your idea would be if we built one of these at 200 tons a day, while building it and operating it for the first few months or a year or so, you would learn more about it than by continuing the smaller operations; is that right?

Mr. SYLVESTER. Yes. I maintained in my testimony yesterday that many of the problems we are faced with today are not laboratory problems, they are not scientific problems, they are not to develop a technique of doing a job in a beaker or test tube, they are engineering problems. I am not thoroughly familiar with the Nossen process,

but I understand the difficulties with the Nossen process are ones of equipment.

Senator MALONE. You mean acquiring the equipment?

Mr. SYLVESTER. Learning how to use big equipment.

Senator MALONE. Your idea then of the way to learn would be to put in such equipment and operate it?

Mr. SYLVESTER. That is correct, sir.

Senator MALONE. Now, do you know of private industries, or private industrialists that would do this job if there were a principle established by Congress, either through duty or tariff or a long-range guaranteed price, that would do the job?

Mr. SYLVESTER. I think I could find some. I might relate to you some of our experiences some time ago.

Some time ago we developed our own particular process strictly on the basis that it could compete economically with foreign ores prior to the Korean crisis.

Senator MALONE. What was the price?

Mr. SYLVESTER. The price at that time was, I believe, about 60 cents a unit. That was a long-ton unit. Of course, we were optimistic, like all process developers, but we never would have gone into it to the extent that we have if we didn't think that the whole project had good chances of economic success.

Our point in going into it, of course, was to try and develop a business which would make a profit. We almost had some bankers to back us. We almost had them convinced that it was a reasonable enterprise.

Senator MALONE. What interfered with that plan?

Mr. SYLVESTER. At that time they naturally went to other people and in this particular case one of the agencies concerned was the Bureau of Mines, which is a natural thing. The Bureau of Mines is considered a pretty good source of information.

The Bureau of Mines convinced them that there was a great amount of risk involved in going into the manganese business, so much so that they withdrew. But, in any event, I firmly believe that a full-scale manganese business can stand on its own feet, once it has gotten started.

Senator MALONE. You mean compete with a world price?

Mr. SYLVESTER. Yes, sir.

Senator MALONE. This Cayuna Range manganese and slag you think could be produced for 70 cents a unit and make a profit?

Mr. SYLVESTER. Given sufficient time for operating experience, I believe it could.

Senator MALONE. How long would it take?

Mr. SYLVESTER. That is a difficult question to answer. I think a full-scale plant could be in operation in 2 or 2½ years. I think their initial costs might be 50 percent higher or a hundred percent higher than their eventual costs, after obtaining normal operating experience.

Senator MALONE. Operating costs?

Mr. SYLVESTER. Yes. We found out on operations of our own on materials of a similar type where initial costs are high, where we sell material for less than it costs, but as we progress, we reach a point where we can reach it without changing the market price and can make it for less than the market price, but we don't do it in the laboratory. I don't think it can be done in the laboratory.

Senator MALONE. Of course, if you compete with the world price, you don't need any principle established by Congress, or any special legislation either, do you?

Mr. SYLVESTER. I am not a financier, by any means, but the question that comes up in promoting any new plan of enterprise is some sort of a guarantee that present-day conditions will hold for a sufficient time to amortize the investment that is involved.

So that I have been asked this question many times: When foreign manganese ore prices were very high and very scarce, when industry was getting them from the stockpile, it looked like any successful manganese business at that time would be a bonanza, but a banker wouldn't consider it so. He said, "How do we know 6 months or a year hence the price won't be half what it is now?"

That is the way it turned out.

Senator MALONE. It is half, but still you say you can compete with it?

Mr. SYLVESTER. I think, given sufficient operating experience, we could.

Senator MALONE. You have no way of knowing how low it could go or would go, if we had a competitive plant?

Mr. SYLVESTER. That is correct. We don't know. The testimony came out on Tuesday that if foreigners couldn't sell the ore at the price they are selling it now, how much lower would they go? We don't have any idea.

Senator MALONE. They have various ways of manipulation, manipulation of money in terms of the dollar, and various ways of subsidizing the sale.

That is the reason I have always been for the Tariff Commission as an agency of the Congress, handling and fixing that flexible duty on that basis of fair and reasonable competition, taking into account any juggling that goes on because they can hear it and rehear it any time. But my ideas, so far, have not prevailed. We are still working under the 1934 Trade Agreements Act and the bill that passed the House, H. R. 1, enlarged the President's powers, 15 percent more reduction in the tariff over a period of 3 years, and other concessions. So we have no knowledge.

What I want, and I think your testimony is very good, that you think within a very reasonable time you can compete with any reasonable world price?

Mr. SYLVESTER. I don't want you to make the error of thinking that I think that can be done as of today. I think there are a lot of good manganese processes. I think a lot of them have come a long way and are fairly close to commercial development, with some help.

Senator MALONE. I understood you. It will take time.

Mr. SYLVESTER. I would rather see, rather than a subsidy of manganese produced in this country, I would rather see foreign ore prices brought up to a point where the users of manganese actually pay for the subsidy, which means the steel users, because the steel companies will pass that increased price along.

Senator MALONE. That would be a duty?

Mr. SYLVESTER. Yes.

Senator MALONE. A flexible duty provided in the 1930 Tariff Act. You think that is the way it ought to be regulated?

Mr. SYLVESTER. That is my own personal feeling.

Senator MALONE. I think that myself, but I am just not sure what we will be able to do this year.

Now, leaving the thing as it is now, you are talking about competing with the world price. What do you have to do to continue your research or get your plant built to experiment on the scale you would like to see it done? Can you do that through private money?

Mr. SYLVESTER. We have a project before EPS now which is well along its way.

Senator MALONE. EPS?

Mr. SYLVESTER. Emergency Procurement Service.

Senator MALONE. GSA?

Mr. SYLVESTER. Yes. We think it is adequate for pilot proof, but it is going to be, if the contract is signed, it is going to be a plant which will not be in existence 3 years from now because it will be a pilot plant built, of partly existing equipment and partly new equipment, and the plant of the Diamond Alkali Co. at Painesville, they happen to have vacant space at the present time, but 3 years from now they might have a new method of making alkali or chemicals or something and require it. We feel that the experience of that pilot plant will certainly enable us to come to GSA or to the bankers, or somebody else and say, "Here are our results on a sufficiently large scale, to give reasonable accurate costs." There is no use approaching a banker without accurate cost figures.

Senator MALONE. You know the world price, you know the price under our bill out of this committee a few years ago, $2.30 a unit. What is necessary to assure that these experiments will go ahead?

Mr. SYLVESTER. In the way of Government legislation or financial help or something like that?

Senator MALONE. Yes.

Mr. SYLVESTER. I feel it could be done several ways. For instance, if some Government agency rather than stockpiling only certain specification ores—if they had the legal right to stockpile finished ferromanganese at some going price over a reasonable period of years—it couldn't be a short-term thing, perhaps it would be in the same spot in a fluctuating market that the bankers always bring up; but if the Government could offer to buy ferromanganese as well as ores, it would be very helpful, over a period of years.

Senator MALONE. What is your idea about the supply in this country? Have you made any estimates? There is talk about Cuyuna Range in Minnesota, deposits in Maine and New England States, deposits in the slags. If, through proper arrangements we might progress to a going-concern industry, what percentage of our present use can we produce?

Mr. SYLVESTER. I think there is absolutely no doubt that we can produce every pound of manganese we require. I don't know how much familiarity you may have with the steel mill practice or where our manganese comes from. That is, that which winds up in the slags. It doesn't come from the imported ores; it comes from the small percentage of manganese contained in our iron ore. Almost all of the iron ores we use contain 1 to 2 percent manganese. Our finished steel, I suppose the average of the industry in ingot form might be three-quarters of 1 percent manganese.

That just happens to be balanced. Now, if all of that manganese that occurs in our iron ore could be recovered—and it can't be—but if it all could, we would need no other source of manganese because it would be a recycling load.

Senator MALONE. What percentage can be recovered?

Mr. SYLVESTER. I would guess 75 percent.

Senator MALONE. Then 25 percent would have to come from some place like the Cuyuna Range?

Mr. SYLVESTER. Yes.

Senator MALONE. Do you agree with some of the witnesses that you have heard here, that if the principle were laid down by Congress, either guaranteed unit price or flexible duty that made up the difference in the cost of doing business here and in the chief competitive country in the production of manganese, do you think that that remaining part of it would be made up from new discoveries and mines that would result?

Mr. SYLVESTER. Yes, sir; I think so, because, by the time we recover three-quarters of our requirements from slags, the technology of large-scale plants will be well enough along that with the slag recovery which is a very low-grade ore in itself, if it is economically practical, the low-grade ore, the upgrading will also be economically practical.

Senator MALONE. You heard the last witness, and our conversation here. I have long contended that if such encouragement were offered on the principle established by Congress, that the mines would be developed, the prospectors would go out into the hills again with their improved methods of prospecting, and development, and exploration, and it takes time, but over a period of years, there would be a substantial going-concern industry in all of the critical metals again like tungsten, manganese, mercury, copper, zinc and lead.

Mr. SYLVESTER. I think our atomic energy program is a very good example of that. I spent a number of years in the ceramics industry. There were 3 or 4 small processes on uranium ore. They used uranium oxide as a coloring in ceramic glazing. There was very little demand. Nobody looked for uranium. The Colorado plateau had some, but nobody paid any attention to it.

However, as soon as we had a necessity for it and it became worth something, surely we had high stimulation through Government support for the uranium mining program, and that is why thousands of people have gone out and dug these gopher holes and pulled out a lot of uranium.

Senator MALONE. I made a report on uranium which was published in 1944. We started to work in 1938. Uranium was only one of many products in this report. Then we made Senate Report 1627 which was published last August which you have probably seen.

Mr. SYLVESTER. I don't recognize it by the number.

Senator MALONE. 1954. You can get a copy of it from our counsel.

We decided that you could become self-sufficient in the 77 critical materials in the Western Hemisphere. As a matter of fact, I said to folks in the Administration who had been saying we had to defend Belgium to get ore from the Belgium Congo, that if we treated our taxpayers half as well as we treated the foreigners, that uranium would be running out of our ears in 2 years. Everyone knows now it will.

I think your explanation is right on the barrelhead, and it would happen in many of these other materials.

Of course, that is the reason for this hearing. We want to know what to do, what the committee can do, or should recommend to the Senate to bring this about.

Our difficulty is we always say the Government wants to improve these industries, but the policies we follow destroy them.

Mr. SYLVESTER. I would like to point out the situation in the rubber business. I think everybody here is familiar with it.

Private industry wouldn't go into the manufacture of artificial rubber. It was financially too risky. There may be some parallel method that could be worked out in manganese and other critical methods whereby the Government would start it on its way, and when it was well on its way, private industry would take over, possibly even buy the plants.

Senator MALONE. You assume in all of your talk here, and most of the witnesses assume that the will is here in Government to do that. The will is not here.

I am on another committee. We are not meeting this afternoon, but we do again at 10 o'clock in the morning on H. R. 1.

Most of the testimony for H. R. 1 is that we must assist these other countries by buying this material from them, and we hold up our allies, and make friends and influence people by buying material we need from them; get it from where we can get it the cheapest.

Have you heard that?

Mr. SYLVESTER. Yes.

Mr. SALISBURY. It should be qualified—not strategic materials.

If they want to send us bananas, I see no objection.

Senator MALONE. There is no qualification. They think we should continue to get all the materials from foreign countries where we can get it the cheapest, meaning cheapest wages, but you see, that helps these countries, and that is what the State Department is trying to do.

You are assuming that we want to build up the manganese industry in this country. I am telling you the majority of the people in Washington do not want to build a manganese industry.

Mr. SALISBURY. The next time we have trouble they will all want to build one. Yet there will be a crash program like many of the programs were at the beginning of World War II.

Senator MALONE. I have seen three of them. I was in the First World War. I served as special consultant to the Senate Military Affairs Committee through the Second World War, and in the Senate through the third world war, and it always happens in exactly the same way. The ambition to secure the material locally fades out with the war.

Now, why did they make the trade agreement on manganese and cut the tariff? They made it because they wanted to import it, didn't they?

Mr. SYLVESTER. I suppose so.

Senator MALONE. They made the same kind of an agreement on tungsten, the same on lead and zinc. You can't assume that we want to build these industries here as long as they do that, can you?

Mr. SYLVESTER. I was born and raised in Denver. When I was a youngster there, there was quite a tungsten industry in Colorado. The Chinese tungsten, when it came in, killed that industry.

Senator MALONE. My bill that is now a law, along with the manganese bill, has put them back, the tungsten industry, in some areas in the country, but only to the extent of special legislation. Your testimony has been good as to what you think is necessary.

Do you have a further statement?

Mr. SALISBURY. I have one further remark in connection with the nontechnical side of this particular proposal of yours.

I want to point out that the security of the Nation is involved here. This manganese problem appears to me to be almost the Achilles heel of our defense program. I also want to point out that I have reason to believe that, judged by the results to date, this program is being actively sabotaged.

I have reason to believe that the policies, which you cannot understand and that do not make sense to anybody who has any familiarity with the subject, are not without skillful minds interested in their origin.

I also suggest that if I were a Soviet agent, that part of the governmental apparatus that I would try to infiltrate first would be the very mineral resource agencies which this committee has to guard.

Senator MALONE. Would you like to read a letter from Harry Dexter White to the Secretary of the Treasury and the Secretary of the Treasury's letter to the President of the United States? It is well indexed in the report you have there in your hands, and it is right to the point. He wanted to lend $10 billion to Russia to furnish these materials to us. We didn't lend the $10 billion to Russia, but we carried out the program with the other nations, like India, which is just as effective, and that is a way of destroying the United States, in my opinion. Nevertheless, that is our policy.

Mr. SALISBURY. It has been a pleasure to appear before you, and if we can give you any information in the future, I hope you will call on us.

Senator MALONE. We will, and your testimony will be returned to you, and if you can round it out and give us any additional information you think would be helpful, we will appreciate it.

Mr. SALISBURY. Thank you.

(Mr. Salisbury supplied the following additional information:)

It has been testified by a previous witness that without a solution to the problem of obtaining a domestic source of manganese in time of war, we will be "sunk". I remind you of his well-chosen word "sunk". When you realize that manganese is essential to the process of making steel, that it now must be transported from such far-away places as Africa, India, and Brazil, that the Soviet Communists are fearfully equipped with deep-lurking snorkle submarines, you can understand why the witness testified that we would be "sunk".

We need not be sunk. The Sylvester process in combination with other methods have been available for 5 years and have been spurned by the Bureau of Mines in its efforts to promote processes developed by its own personnel and by the manganese panel of the National Academy of Sciences in the interest of the "status quo". A study of the private interests of the members active on the manganese panel of the National Academy of Sciences should convince any member of this committee that no process which threatens the very existence of the vast investments of its members in foreign located mines will receive support. Legislation should be considered by this Congress to make it a crime for a person to appoint to a panel or committee of the National Academy of Sciences passing on the merits of new projects any person who directly or

indirectly through employment or ownership has a financial interest in the field under appraisal. If this had been the statutory law, much greater progress in science would have been possible to date in the development of new processes for strategic resources over the last few years. Small business, small miners, small enterprisers would not have been deprived of the traditional fair deal which so characterizes the healthier areas of our economy.

We need not be "sunk" for enough pure research has already been done. The report of the Bureau of Mines on the Sylvester process (No. 4847, published by the United States Department of Interior in February 1952) indicates that the broad principles of the Sylvester patents have been substantiated and this is all that laboratory research can do. Similarly the report of the manganese panel of the Metallurgical Advisory Board of the National Academy of Sciences (Report MAB–10–M, dated December 21, 1951) entitled "Production of manganese for domestic sources" shows that in combination with existing processes, the Sylvester concentrate is technically feasible for open hearth slags and domestic ores. Surely the time has come to engineer these processes, to take them out of the laboratory, to put American genius into a demonstration plant. Soviet Communists will wish us to confine our efforts to the time-wasting dalliance of the state-capitalist government laboratory, the ferromanganese vested interests will propose delay until a crisis requires immediate attention. It may then be too late and the witness' prophecy that we will be "sunk" will have come true.

We need not be "sunk" for not only can the lime-clinkering process in combination with Nossen. Dean, and others, as the previous testimony of the Southwestern Engineering Co. demonstrates, recover the iron and manganese from open hearth slags and Aroostook County ores, but the small domestic miner will be able to supplement the manganese recovered from slags with an ample supply of upgraded domestic ores. One hundred percent of our steel industry requirements for their metallurgical grade ferromanganese will then be on hand or representative prototype plants will be available as models for immediate expansion in case of Soviet Communist aggression.

This Committee might consider the following suggestions for legislation to remove the manganese sword of Soviet Communist Damocles swinging over our heads:

(1) Provide funds for engineering of pilot plants for processes determined by independent scientific agencies to have promise. No person or agency having a competitive process or having a financial interest directly or indirectly in the status quo can participate in such appraisal.

(2) Require that the projects be carried on by competitive contracting with private, public, or United States Research agencies in the manner which the Office of Naval Research, and other defense research officers so successfully administer their programs.

(3) Provide loan support for the building of commercial plants for upgrading stockpile, and low grade domestic ores and a guaranteed price and purchase for a period of years sufficient to amortize the cost of building the plants, provided that the independent agency, above referred to, will certify that the project has a reasonable probability of commercial success.

(4) Provide a program similar to the artificial rubber program of World War II for the building of prototype plants where the agency certifies that no plants of probable commercial success for the material concerned have been proposed.

(5) Eliminate by law the possibility of the use of panels of the National Academy of Science or other quasi-governmental offices to preserve the vested interest of big business and big Government.

(6) Protect the producers of domestic manganese from importation of foreign manganese mined by labor receiving less than the minimum wage paid to domestic miners. Prefer domestic production of all strategic resources. Consideration should be given to the development of Cuban sources for managanese, iron ore, kenaf, and other strategic materials as the distance of Cuba from the United States is but 75 miles.

It is respectfully submitted that adoption of the above program by the United States of America will ensure our safety now so grievously in jeopardy by our lack of defendable and dependable sources of ferromanganese.

FRANKLIN C. SALISBURY.

Mr. ADLERMAN. Mr. L. B. Manning.

Mr. Manning, would you state your full name and qualifications?

STATEMENT OF L. B. MANNING, GENERAL MANAGER OF THE TROUT MINING DIVISION, AMERICAN MACHINE & METALS, INC., PHILIPSBURG, MONT.

Mr. MANNING. My name is L. B. Manning, general manager of the Trout Mining Division, American Machine & Metals, Inc., Philipsburg, Mont.

Mr. ADLERMAN. Mr. Manning, do you have a prepared statement?

Mr. MANNING. No.

Mr. ADLERMAN. Will you tell us something of the type of work you are doing now?

Mr. MANNING. For the last 30 years this company has been a producer of battery grade manganese dioxide. At present we are shipping both to commercial companies and to Government stockpile.

The history of the present situation in regard to this battery material is that this is the only domestic deposit that presently is meeting GSA's P-29 specifications.

Our contract is about to run out, which we had been led to believe would carry through 1958. But some place in the process they felt the stockpile wasn't being satisfied rapidly enough.

As I understand, the balance of the tonnage has been made up of foreign material, so that they now consider the stockpile adequate.

Mr. ADLERMAN. Did they contract for it abroad?

Mr. MANNING. Yes. I presume it has been delivered. I don't know.

Mr. ADLERMAN. You don't know whether it has been delivered or not?

Mr. MANNING. No.

Mr. ADLERMAN. Or what the terms are of the foreign contracts, or dates of delivery?

Mr. MANNING. No.

Mr. ADLERMAN. When did your contract terminate?

Mr. MANNING. The contract date is June 30, but we will probably complete the contract at the end of May of this year.

Mr. ADLERMAN. Now, have they discussed with you—have you discussed with them whether they completed their long-term objective or short-term objective?

Mr. MANNING. I believe it must be their long-term objective, because they have to go to the Office of Defense Mobilization to get any further authorization for purchase.

Mr. ADLERMAN. Have you entered into any discussions with them about renewal of the contract?

Mr. MANNING. We have, yes, and we are quite concerned about it, because our present production rate is about 1,000 tons per month to the stockpile and about 250 tons a month to the commercial people and the contract is necessary to avoid a shut down.

Mr. ADLERMAN. Whom are you discussing this with?

Mr. MANNING. We have talked both to General Services Administration and Office of Defense Mobilization.

Mr. ADLERMAN. Who in General Services?

Mr. MANNING. In the Emergency Procurement Service. Mr. Hubbard, I believe, who has now moved to the Agriculture Department, to be in charge of barter, as I understand it.

Mr. ADLERMAN. You mean they are going to trade surplus agricultural products for battery grade manganese, is that what you are given to understand?

Mr. MANNING. Yes.

Mr. ADLERMAN. Have you discussed this with ODM?

Mr. MANNING. Yes, we had one meeting with them and they seemed quite sympathetic to our case. The fact that we have pressed it is for two reasons:

One is that, as I say, it is the only domestic deposit that presently meets the required specifications, and if it is dumped into the metallurgical stockpile, what we consider as positive ore, probable ore, and possible ore is about 10 years additional production at about the same rate we are presently producing, it would then be lost as battery material.

If that material is dumped into the metallurgical stock pile, of course, it is of very minor importance, but in the battery stockpile it is of very considerable importance.

Mr. ADLERMAN. Is there any disposition right now to mix the ores or the metals?

Mr. MANNING. You mean in the stockpile?

Mr. ADLERMAN. Yes.

Mr. MANNING. I would presume that since the only purchase depot is at Butte—we have none at Philipsburg, only for carbonate—it would be dumped in with any other oxide that is presently being bought.

Mr. ADLERMAN. That would be neither wise nor economical, would it?

Mr. MANNING. No; because it would be very difficult or impossible to try to segregate it later.

Mr. ADLERMAN. What price did you get on the battery grade ore?

Mr. MANNING. $86 per short ton and grade was above specifications. It compares just about evenly with the present stockpile price for a metallurgical product of that same grade.

To give a little additional history, our company's processing plant burned down in 1950, and in the consideration of rebuilding the plant at that time, was involved the disposition of our product.

We had then become, costwise, practically out of the commercial battery picture, and it was on assurance from General Services that they expected to be buying over a considerable period of time that this mill was rebuilt and put into operation.

Of course, we have only completed about half the time limit as far as our productive capacity is concerned.

Mr. ADLERMAN. You say you are the only producer of battery grade ore in the country?

Mr. MANNING. That is correct.

Mr. ADLERMAN. And what is the capacity of your mine?

Mr. MANNING. The capacity of the mine?

Mr. ADLERMAN. Of the mill.

Mr. MANNING. The capacity of the mill is 80 tons a day. In addition to this manganese dioxide, we are producing a small amount of carbonate ore. We also produce 2,000 to 2,500 tons of silver, lead, and zinc ore from the same mine.

Mr. ADLERMAN. In fixing the stockpile objectives, have they consulted with you?

Mr. MANNING. No.

Mr. ADLERMAN. You have no idea what the objectives are?

Mr. MANNING. No.

Mr. ADLERMAN. They have never revealed those figures to you?

Mr. MANNING. No.

Mr. ADLERMAN. You don't know whether they are adequate or not?

Mr. MANNING. No; we have no way of knowing that.

Mr. ADLERMAN. Have you dealt with anybody else in GSA besides Mr. Hubbard?

Mr. MANNING. Mr. Chaffee, I think, is of about the same stature in the organization of GSA, and I have talked to him on previous visits. The last time I was here three weeks ago our discussion was entirely with Mr. Hubbard.

Mr. ADLERMAN. Have you discussed it with Mr. Fredell at all?

Mr. MANNING. No. We were recommended to discuss with Mr. Fredell the research program that we have under way, which involves a different type of material entirely.

Mr. ADLERMAN. Whom have you discussed this with in ODM?

Mr. MANNING. Mr. Floyd and Mr. Curtis, I believe they are the ones.

Mr. ADLERMAN. Have they given you any hope of continuing your contract?

Mr. MANNING. Well, as I say, they simply indicated that they were sympathetic toward the fact that we have a considerable plant investment that we may have nothing to write off against, and a certain number of men who would become unemployed, plus the consideration that if this material disappears into the metallurgical stockpile, it is never again available for battery purposes.

Mr. ADLERMAN. Are they aware that the other requirements of the stockpile are going to be met through the barter arrangement?

Mr. MANNING. All I have to go on there was Mr. Hubbard, in a joking way, when he told me they would barter some butter for manganese, and I told him I would take distilled grapes in preference.

Mr. ADLERMAN. You don't know the facts behind that?

Mr. MANNING. No. General Services are only the buying agency. If they are directed to buy from us, they are perfectly happy. Over a period since 1950, we have had a number of contracts with them which we have always fulfilled in a satisfactory manner, and generally before the expiration date of the contracts. I think they feel we are responsible people to do business with.

Mr. ADLERMAN. Do you have anything else that you think you can offer to the committee by way of discussion?

Mr. MANNING. I might offer a suggestion, because we are also somewhat interested in the carbonate ore situation.

When this program was first instituted, we presumed we would be able to ship, as we did during the last war. My company supplied 65 percent of the material in the Philipsburg stockpile, which at that time was purchased on the basis of manganese content alone. The new program now takes into consideration the lime and magnesia content, which also has been subjected to a re-assaying situation wherein, what previously used to be reported as being lime and magnesia content, is now about one and a half times what it used to be, which now brings us out of a nonpenalty bracket into a penalty bracket.

As a consequence, we have only produced a small amount, incidental to our silver, lead and zinc operations.

Mr. ADLERMAN. They changed specifications on you?

Mr. MANNING. They added that in the specifications, that the lime and magnesia would be allowed 7 percent free. Most of ours combined runs about 11 percent.

We sold last year about 4,000 tons to the Taylor-Knapp Co., neighbors of ours in the area, and they processed it with material of their own. That was limited to when they had low lime and magnesia material of their own to mix with ours in their process. We currently have a development, a joint development program, with Defense Minerals Exploration Agency, which is designed to bring in some carbonate ore reserves, and if this penalty continues, it was really a foolish development move, since we may develop some carbonate ore, but we will still be prevented from doing anything with it on account of the lime and magnesia content of it.

We are quite interested, if there is going to be so much change in the program, that there is something done about eliminating the penalty for lime and magnesia and the price be based on manganese content only.

Mr. HOLDERER. What is the source of the battery manganese of the battery makers of this country? Do they buy from you or is most of that imported?

Mr. MANNING. We sell to one customer, the Ray-O-Vac Co. For certain purposes, the Philipsburg natural ore does a better job than either foreign material of higher grade or a synthetic product, but that has a limited use, which has been, I would say, an average of about 250 to a maximum of 300 tons a month, which would mean that operated for commercial purposes only, we couldn't run the mill at that small capacity and expect to make any money on it.

Mr. HOLDERER. You have been getting a premium from the stockpile for that?

Mr. MANNING. I wouldn't say a premium. We have been getting approximately the same price, translated in value of manganese units, as if the material were shipped into the metallurgical stockpile. General Services more or less has set that pattern.

Mr. HOLDERER. It seems rather too bad to have stuff of that grade go into the metallurgical pile.

Mr. MANNING. Yes; because that is our only alternative. We have a developed property up to a very considerable point, and we can't just forget about mining indefinitely. We presume that we might get a contract, we will say, for a year's time. That really is only, we might say, a sop, because, unless we are assured of a little longer-term operation than that, we are better off to start shipping the material to the metallurgical stockpile and dump as much of it in there as we can in the next 3 years, before the program is over.

Mr. HOLDERER. How long do you figure it will take you to figure your Defense Minerals Exploration Agency program?

Mr. MANNING. We are in the process now of driving through some bedded ore that was cut by a diamond drill, and I presume that possibly the next 3 months should somewhere near complete that project, and as I say, what we develop, unless there is some change in the specifications will not be a mineable grade. I believe we wrote a proposal to you at one time, that if the Government would buy over a

period of time, minus this lime and magnesia penalty, that my company might give consideration to the erection of a plant to treat the material, which of course is not presently salable as a concentrate. It is salable as a crude ore, but the stockpile doesn't take into consideration any type of concentrate other than they have made an allowance on magnetically treated material which is what the Taylor-Knapp Co. has been doing.

Mr. HOLDERER. Have you taken up this matter of analysis recently again with Mr. Fredell?

Mr. MANNING. No. Do you mean about the carbonate ore?

Mr. HOLDERER. Yes.

Mr. MANNING. No; we never have. We just presumed that that specification was set for a program over a considerable period, and it was impossble to get any amendment until we heard it suggested today that they amend the price for oxide ore at the Butte stockpile, and we thought if they were going to amend for one particular product, they could amend something on another product.

Mr. ADLERMAN. Thank you very much, Mr. Manning. Your information has been very interesting to us, and not only from the purchase program, but from the stockpile program.

I would like you to wait a while and let me talk to you a bit.

STATEMENT OF J. CARSON ADKERSON, PRESIDENT, AMERICAN MANGANESE PRODUCERS ASSOCIATION

Mr. ADKERSON. My name is J. Carson Adkerson. I appear as president of the American Manganese Producers Association and for myself as an individual operator in manganese. The association is a national organization composed of manganese producers in the United States. It was organized in 1927 for the expressed purpose "to further the production, beneficiation and use of domestic manganese bearing ores."

I am a mining engineer registered and licensed under the laws of the State of Virginia and the District of Columbia. I have been in the manganese industry continuously since 1912. I have worked in the mines. I have served as a mucker, miner, timberman, mine foreman, mill operator, mill superintendent, engineer, mine manager and operator.

I have visited and examined most of the manganese areas in the United States and Cuba.

I am not going to take up the time of the committee to go into detail, but I have here a description of a manganese plant, prepared and published by the United States Geological Survey, which describes the first mill ever built in the United States using modern means of concentration on low-grade manganese ores. There were no books to go by, no precedent in the world that I then could find.

I designed and built that plant, even saved the fines and produced what is recognized as the highest grade manganese concentrate then ever shipped, in the United States.

That was done during the years 1916 to 1919. I went out into that mountain area horseback and had other men come in by horseback and afoot. There were not even roads enough to carry a Ford car or a buckboard. We cut down trees, built shacks, opened roads, developed the mine, and built the plant. Government geologists named G. W.

Stose and H. D. Miser, two of the most outstanding geologists of the United States Geological Survey, now retired, but still living, were there, and they prepared and published this report.

I would like the privilege at this point of inserting in the record a short excerpt from this report giving a description of that operation and method of concentration.

(The matter referred to follows:)

[From Virginia Geological Survey Bulletin No. XXIII—Manganese Deposits of Western Virginia, by G. W. Stose and H. D. Miser, prepared in cooperation with U. S. Geological Survey, 1922]

POWELLS FORT MINE, SHENANDOAH COUNTY, VA.

Mining and preparation of ore: The Stockwood Realty Corp. developed the mine during 1916 to 1919 by 2 inclined shafts and 2 vertical shafts, all connecting with a definite underground system of cross-cuts and drifts. (See pl. XXIII.) Since the development of the underground system the inclined shafts have been used as chutes to carry timbers to the underground levels, and the main vertical shafts have been used for hoisting ways for the ore. Considerable trouble was at first experienced by the soft flowing wet sands in the ore formation but by locating the shafts far enough from the outcrop of the ore zone to gain sufficient depth before puncturing the quartzite hanging wall (see sections on pl. XXIII) and by a special system of working on the lower level this trouble was completely overcome.

The deposit was developed and operated for a distance of approximately 600 feet along the strike of the ore-bearing formation and to a depth of approximately 150 feet. The underground system consisted of three main levels on which cars were operated, with several sub-levels between. The ore, after being broken from place, was handled by gravity through chutes to cars on the main level next below and conveyed to the shafts where the cars were hoisted out and then continued by gravity to the mill.

The mill was modern and was completely equipped with crushers, washers, picking belt, rolls, jigs, and tables, so that the finest particles of ore were saved. The ore was handled in the mill largely by gravity and automatic machinery. The ore from the picking belt ran from 80 to 87 percent manganese dioxide (MnO_2), less than 1-percent iron, and low in silica and other impurities. The jigs yielded products ranging from 76 to 84 percent manganese dioxide, 0.50 to 1.50 percent iron, and 4 to 6 percent silica. The tables with 12 and 24 mesh screens yielded a product averaging 80 percent manganese dioxide, 1.50 percent iron, and 5 percent silica. The ore was shipped in barrels and bags to plants of the National Carbon Co., for dry-battery manufacture.

The mine was closed in 1919 on account of the dumping of low-cost foreign ores in the United States.

Following that, after making investigations of other manganese deposits in the United States, I carried forward developments in manganese in other parts of the State of Virginia, shipping while developing ore reserves. In 1920, associates and I developed a research laboratory and pilot plant for experimental work in the recovery of manganese products from low grade ores. In 1924 we built a large-scale pilot plant which continued in successful commercial operation until 1930, when superseded by our large-scale commercial plant, an exact replica of the smaller pilot plant. The larger plant, with a capacity of 30,000 tons of ferro-grade ore per year, was the most modern manganese concentrator known at that time, using modern methods of gravity concentration.

These operations and plants were in the Cedar Creek area, Shenandoah County, Va., under the names of the Hy-Grade Manganese Co. and Hy-Grade Production & Sales Corp.

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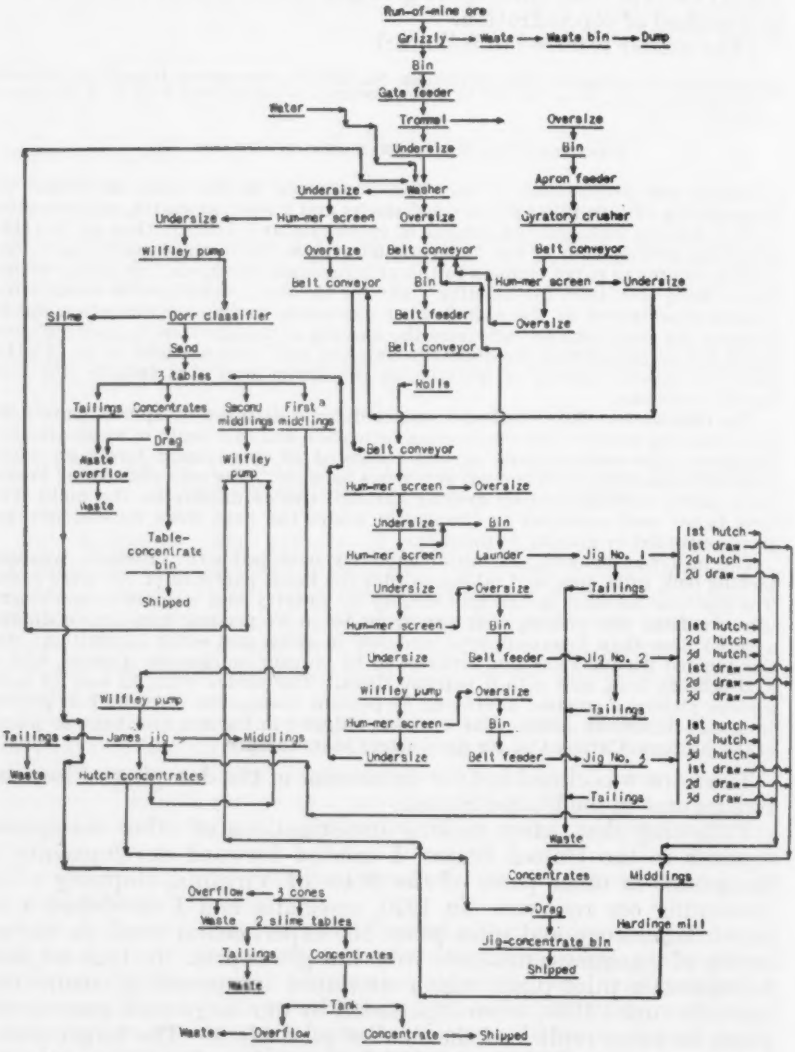
I have here a picture of the pilot plant built in 1924 and the main plant built in 1930, together with a flow sheet and description of the plant and process as described and published by the United States Bureau of Mines, which description I submit for the record.



[a] First middlings nearest concentrate.

FIGURE 7.—Flow sheet of Hy-Grade Manganese Production & Sales Corp., Cedar Creek Mill, Woodstock, Va.

[From U. S. Bureau of Mines Bulletin I. C. 6768, May 1934]

CEDAR CREEK MILL

Construction of a modern mill, with a rated capacity of 30,000 tons of ferrograde ore per year, was begun in 1929 by the Hy-Grade Manganese Production & Sales Corp. and completed late in January 1930. Inasmuch as this mill is the newest in the country and embodies modern methods of concentration the flow sheet (fig. 7) will be discussed in some detail.

Because the general character of the ore treated is much the same as that in residual manganese deposits throughout the Appalachians, the same general flow sheet, with small changes to take care of the peculiarities of each ore, will no doubt be found applicable to other ores.

The ore is trammed to the mill grizzly, which has openings of about 4.5 inches. The oversize is low-grade and is rejected, and the undersize constitutes the mill feed.

The mill feed passes to a trommel with 1¼-inch holes, where the screening is done without the addition of water. The undersize is washed in an Elmore washer to remove the clay. The washed material passes to a set of rolls, where it is crushed to one-half inch. The trommel oversize is crushed separately in a gyratory crusher.

The minus one-half inch feed is screened into 4 sizes by Hum-mer screens, and each of the 3 coarser sizes is treated separately on Harz-type jigs. The finest size and the undersize from the Ellmore washer are de-slimed in a Dorr classifier. The flow sheet shows the sand from the Dorr classifier distributed to three tables. A change has since been made so that the sand product passes to a hydraulic classifier, and a classified feed is fed to the tables.

Middlings from the jig are ground in a Hardinge ball mill and pumped back to the Elmore washer for re-treatment. The hutch product from the Harz jigs, plus the table middlings, are re-treated in a James jig. Slimes from the Dorr classifier and the hydraulic classifier are dewatered by 3 cones and concentrated on 2 slime tables.

The advantage of feeding a classified product to tables instead of a distributed feed was brought out well at this mill. Installation of a multiple-spigot classifier resulted in an increase in the capacity of the tables and a decrease in the manganese content of the table tailings from about 11 to about 2 percent compared to results with a distributed feed.

The metallurgical results at this mill are quite satisfactory; the concentrates are suitable for metallurgical purposes, and the recovery of manganese is high considering the type of ore treated. It might be added that the company also hand-picks and cobs some of the ore in the open pit to produce a chemical-grade product. The output of the mill, except a small tonnage ground by the company for use in the ceramic industry, is consumed by steel plants.

The metallurgical results at this plant were satisfactory and proved beyond doubt that a high recovery of manganese can be made from the average low-grade ores of the Appalachian area by gravity concentration.

At the start of operation of this plant, while we were endeavoring to arrange 6-month contracts with consumers, we were informed that the Soviets had offered to undersell any domestic producer, regardless of the price that the domestic producer would quote. That included our operations.

This mine and plant represented an investment of over a million dollars. The mill cost approximately $300,000. It had a capacity of 30,000 tons per year, meeting all specifications.

The Soviets put us out of business in 1930. We could not sell a ton. They carried out their threat of dumping and closed all mines in the United States.

I personally and at my own expense kept the plant and mine open in operating condition until 1936. In 1936, under the reciprocal trade agreements, the tariff was cut in half. I walked away and abandoned that mine and plant after a $1,000,000 investment, and never got another thin dime out of it. The timbers rotted and the mine collapsed.

Since World War I, each time that we have started operations foreign impoorts have come in and closed domestic mines. This has been largely through imports or threatened dumping from Russia.

The same thing happened in 1927. The same thing happened in 1930. The same thing happened after World War II.

In each instance when we have started domestic developments the Soviets have dumped or threatened to dump, and have closed the manganese mines in the United States.

We are facing that same situation today. This time it comes in the guise of barter trade with Soviet manganese for United States butter.

Now this hearing is largely on research and beneficiation. I am in favor of research and experimental work in the processes. But I want to state firmly that what gives the greatest stimulation to the manganese industry is a market and a sustained market at a price. The best illustration is what has been done. The proof is in the pudding.

During the last year domestic producers shipped approximately 200,000 tons of high-grade ore; and in addition approximately 300,000 tons of low-grade ore which went into the low-grade stockpiles in the West.

The processes are known. Most of these processes which have been discussed today have, in effect, been known since 1930.

I have here an excerpt from a publication of the Bureau of Mines in 1929 which I ask to be inserted in the record. It outlines the seven different known processes as of that time.

(The matter referred to follows:)

Manganese and Manganiferous Ores in 1929, United States Bureau of Mines, pages 295 and 296, states as follows:

"In view of the fact that there is possibly 200 million tons of low-grade manganiferous material in the United States to which certain beneficiation processes may be applied in the future, it may be of interest to outline the occurrence of manganese ores and the methods that have been developed for treating these ores.

* * * * * * *

"The methods developed, so far, for the treatment of the different types of low-grade manganiferous ores may be summarized as follows:

"1. Gravity concentration:
- "(*a*) Jigs
- "(*b*) Tables
- "(*c*) Log washers
- "(*d*) Sluices
- "(*e*) Flotation (ordinary)
- "(*f*) Heavy-liquid method

"2. Chemical beneficiation:
- "(*a*) Ammonium sulphate leaching by the Bradley process.
- "(*b*) Hydrochloric acid leaching by the Leute process.

"3. Pyrometallurgical:
- "(*a*) Bureau of Mines blast-furnace method.
- "(b) Roasting of carbonates or oxides.

"4. Magnetic separation:
- "(*a*) Straight magnetic separation.
- "(*b*) Roasting followed by magnetic separation.

"5. Selective flotation to remove deleterious constituents.

"6. Volatilization.

"7. Desliming of limonite and other soft oxides.

"8. Combination of the first seven methods."

Mr. ADLERMAN. Has there been a change in the number of processes?

Mr. ADKERSON. There are a number of processes but few of them new. My plants were largely gravity concentration, but gravity concentration in which I saved the fines and recovered approximately 80 percent of the contained manganese.

Following that, the next great development came in what we call flotation. That was worked out by the Bureau of Mines and first applied through the Cuban-American Manganese Corp. in Cuba on low

grade ores which were even of a lower grade than the low grade ores in the United States. Most of it was wad ore. The process was successful. I submit for the record copy of a letter from the Cuban-American Manganese Corp. dated May 12, 1933.

(The letter referred to follows:)

CUBAN-AMERICAN MANGANESE CORP.,
New York, May 12, 1933.

Mr. J. CARSON ADKERSON,
President, American Manganese Producers Association,
National Press Building, Washington, D. C.

DEAR SIR: We are in receipt of your letter of inquiry regarding the manganese situation and information as to our operations in Cuba.

We have been operating a mill, using a new process, for the last 6 months.

The average grade of the ore treated has been slightly under 19 percent metallic manganese. Our extraction has varied from 65 to 87 percent in the mill. Positive indications in the mill are that much lower-grade ore can be successfully treated.

The grade of the product we have produced and shipped has ranged from 52.4 up to 55.03 percent metallic manganese and we have sold every ton that has been produced to date.

The production capacity in concentrates is 300 tons daily.

There is no necessity of giving you operating and metallurgical details as we understand you desire only the fact that low grade manganese ores can be successfully and commercially mined and milled for American consumption. Our operating, shipment and consumers records give the best proof of the commercial value of low-manganese ores.

Yours truly,

F. D. NORCROSS, Jr.,
Resident General Manager.

That same method has been improved on and is now being employed by the Anaconda Copper Mining Co. at Butte and Anaconda, Mont., largely on the carbonate ores. It is successful.

The same method is employed by the Domestic Manganese & Development Co., as explained by Mr. Cole before this committee this morning, and which applies also to the oxide ores. That process is successful when treating carbonate ores alone or oxide ores alone.

The same method is also being employed by Manganese, Inc., testimony on which was given by Mr. West, president of the company, before this committee a couple of days ago. That is successful.

Those things are known today and are being applied and can be expanded in case we are given a sustained market for a long enough time to justify the investments being put in. It is nothing more or less than these plants here exactly duplicated at dozens of points in different areas of the United States.

There are other ores in the United States which require a more intricate process than this, such as the ones you have heard discussed, namely, chemical, which goes further than gravity concentration or flotation. Research on those processes should continue, but there is nothing to keep the expansion or the production from these plants from going ahead now except an extension of the markets. More important than all the research is extension of the markets as proposed in bill S. 920, introduced by Senators Murray, Hayden, Goldwater, Mansfield and Martin. That bill would give a market for the low-grade ores at other points in the Appalachian area, in Arkansas and other points where sufficient ore is known to justify low grade buying depots. It would give the extension of the market for a longer period

of time on the high grade ores which will justify the installation of plants.

I do not mean that these are the only processes. Since that time we have applied heavy media and electrolytic recovery of manganese which, in instances, might be used rather than these processes, but you need to go no further than what has been done to bring forth successful operations. Any one of them can be improved upon by constant research and study.

I would like to submit more information which would go into the record, but I know that you are trying to bring the hearings to a close.

Mr. ADLERMAN. You will receive a copy of your testimony before it goes into print. At that time you can expand upon it or fill out what you feel should be filled out, change it as far as the substance goes, and make it more accurate, and so forth. You may add anything in the way of additional information in which you think the committee will be interested.

Mr. ADKERSON. I will be glad to do that.

Before leaving the stand I want to say that we are talking about and discussing before the committee what might be done 5 or 10 years from now. At the present moment you have miners operating and delivering ores to the Wenden stockpile in Arizona. It has been testified before this committee that that stockpile is going to be closed down at the end of this month.

Why discuss research on what is to come if you do not keep the known production going?

The same thing happened in the Appalachian area. We are mining and shipping high grade ore, throwing aside the low grade for which there is no market. The average producer would have to build a plant somewhat similar to this, only smaler, which would cost in the neighborhood of $200,000 to recover the manganese from the low grade ores.

We hope that the Government will install a buying depot in the Appalachian area which will use these low grade ores, and install a plant at a central point so that each individual producer will not have to install his own individual plant at such a cost to him with the chance of having the rug pulled from beneath him as has happened to us time and time again.

I have sworn that I would never again, on my own, go into this or encourage anybody else to put a million dollars into a mine and plant and have the rug pulled from under him without a market after it is completed.

Therefore, I say that the most essential thing that this committee can do, that Congress can do, that the administration can do, is to guarantee us a continued market for the low grade stockpiles now in operation, for the carlot high grade buying program now in operation, expansion of the program to other areas and let the producers, who know what to do, go ahead and install plants and produce ore, and let the research continue.

If there is any doubt in the minds of any of the members of this committee on the availability of processes or the availability of domestic reserves sufficient to supply this country with 40 percent of our consumptive needs, I refer you to a release by the Secretary of the Interior, Harold L. Ickes, under date of February 9, 1942, wherein he outlines a program that has been developed by the Bureau of Mines

of sufficient scope to free the United States from all overseas sources. I submit a copy of this release for the record.

(The matter referred to follows:)

DEPARTMENT OF THE INTERIOR INFORMATION SERVICE

BUREAU OF MINES

(For release in a. m. papers of Monday, February 9, 1942)

A domestic manganese war program of sufficient scope to free American steel and alloy production from its present reliance on foreign sources with accompanying dependence on ocean shipping or naval convoy, where necessary, has been developed by the United States Bureau of Mines, Secretary of the Interior Harold L. Ickes announced today.

The program, designed to provide sufficient manganese to produce 87 million tons of steel annually, covers utilization of low grade domestic manganese. It was made possible through the development of several processes which have been tested by the United States Bureau of Mines during years of study, in laboratories, and in pilot plants in the West, provided by Congress for that particular purpose.

Manganese has been classified as a first priority strategic mineral considered indispensable to the manufacture of steel with some 12 pounds usually required for each ton of steel. Manganese is an essential ingredient of steel used for tools, armorplate, ships, and machinery. Over 90 percent of the manganese normally is imported, chiefly from Southeast Asia, Brazilian, and Cuban ports, and there is a considerable supply of such imported manganese in the United States for immediate but not future needs.

The Bureau of Mines reported that in order to secure rapid use of the program, it was prepared:

> First, to make available its knowledge, experience, technical personnel, and processes to industry so that industry can benefit from the work the Bureau has done, and to supervise operations if industry so requests.
>
> Second, only in the event industry is unable to undertake the production rapidly, the Bureau of Mines is prepared to assume responsibility for the necessary production itself at the request of the War Production Board.

The specific program provides for the establishment of 8 mills, 3 hydrometallurgical plants including 1 electrolytic unit, and 1 matte smelting plant. The proposal is to establish these 12 plants in 10 locations in 8 States. The States are Arizona, Arkansas, Minnesota, Montana, Nevada, New Mexico, South Dakota, and Utah. All these plants can be in operation at the end of 1 year, and many at the end of 9 months. It is believed that even with an increase of imports from Cuba and Mexico a reduction of shipping from other foreign sources may result in a deficiency in manganese in 1943 without additional processing of domestic ores. Supplies sufficient for the present year and part of 1943 are now on hand.

The work of the engineers of the Bureau of Mines has continued for a number of years and has been intensive over a 2-year period. Congress authorized and financed this work in manganese by a $2 million appropriation made available to the Bureau through the War Department. During the period of testing and experimentation an industry committee representing the larger manganese and steel producers, which is attached to the National Academy of Sciences, was kept advised of the progress of the work.

The engineers of the Bureau of Mines report that they do not hesitate to stake their professional reputations on the feasibility and workability of the processes they have tested. They state that relatively little high priority material is needed for the construction of new plants for production.

Careful calculations indicate that a capital investment of less than $38,000,000 in mining operations and processing plants will be required to produce the amount of manganese specified. At prices only slightly above the present price of $75 per ton for pure metallic manganese in nodulized concentrates at Butte, Mont., the whole capital cost can be amortized in 3 years. After amortization, the price is expected to be 20 percent below the present price. A minimum of 526,000 tons of metal annually is provided for in the program with a maximum of approximately 560,000 tons. This includes 12,000 tons of electrolytic manganese which is of special value in low carbon steels, for shells, and in certain

types of stainless steels. Approximately 11,500,000 tons of domestic ores can be processed annually.

The program proposed by the Bureau of Mines is divided into two steps. Six custom mills and one hydrometallurgical plant can be established first, using the higher grade ores. After careful consideration of the larger resources available and the methods of treatment suitable to each ore, the following locations were proposed: Customs concentrators at Deming, N. Mex.; Batesville, Ark.; Parker Dam, Ariz.; Philipsburg, Mont.; Delta, Utah; Garfield, Utah; and Las Vegas, Nev., where a leaching plant and electrolytic plant can be established. These plants could produce a minimum of 213,620 tons of manganese metal equivalent annually, and would require an investment of $14,100,000.

The second step in the program includes plants at Artillery Peak, Ariz., on the Cuyuna Range, Minn. and at Chamberlain, S. Dak. These plants could produce a minimum of 312,175 tons of manganese metal equivalent annually, and would require an investment of $24,000,000.

Fifty different ore bodies could be used in the program, including properties in the Batesville-Cushman District in Arkansas, the Aquila, Parker Dam and Wickenburg areas in Arizona, the Paymaster District in California, Granite County, West Butte and Wickes areas in Montana, Drum Mountain, Simpson Mountains, Kanab, Maryville and Tintic Districts of Utah, the Caliente, Ely, Pioche, Battle Mountain, Valmy areas of Nevada; Three Kids, Annex and Las Vegas-Wash areas of Nevada, the Cleveland area of Idaho, the Cuyuna Range area of Minnesota and the South Dakota area near Chamberlain.

Several of these ore beds could be exhausted, during the war period, but others could with the new processes, be used to supply the Nation's steel needs for many years. The largest deposit, although of very low grade ore, is at Chamberlain, S. Dak.

The program proposed by the Bureau of Mines includes the advance purchase of ores during the period of construction of the mills and hydrometallurgical plants so that full operation could be obtained rapidly.

Dr. R. R. Sayers, Director of the Bureau of Mines, stated that the research and experimentation work which made the Bureau confident that it could help support the Nation's war steel program for many years was in charge of Dr. R. S. Dean, Chief, Metallurgical Division, and that in addition to the Bureau's experts, professors of several universities had been employed by the Bureau for the work. Most of the experimentation work was concentrated at the Boulder City, Rolla and Salt Lake City laboratories.

I thank you.

Mr. ADLERMAN. Thank you very much for your testimony. It was very illuminating. You will be given an opportunity to go over it.

I think that we will adjourn the hearings now unless there are any further witnesses who want to be heard.

The meeting is adjourned.

(By direction of the chairman, the following is made a part of the record:)

BATTELLE MEMORIAL INSTITUTE,
Columbus 1, Ohio, April 25, 1955.

Mr. JEROME S. ADLERMAN,
Counsel, Minerals Subcommittee,
Senate Office Building, Washington, D. C.

DEAR MR. ADLERMAN: This letter transmits my prepared statement for the Minerals Materials and Fuels Economic Subcommittee of the United States Senate Committee on Interior and Insular Affairs concerning the hearing on the United States manganese stockpiling program.

I am sorry that I was unable to remain in Washington to give this testimony in person. If I can be of any additional help to the committee, please do not hesitate to call on me.

Yours very truly,

F. M. STEPHENS, Jr.,
Chief, Extractive Metallurgy Division.

PREPARED STATEMENT OF F. M. STEPHENS, JR., CHIEF, EXTRACTIVE METALLURGY DIVISION, BATTELLE MEMORIAL INSTITUTE

Although the United States currently imports almost all of the manganese ore required to sustain our expanding steel industry and, for this reason, has been referred to as a "have not" nation as regards manganese, this is, to some extent, an unjustified designation. As a matter of fact, according to United States Bureau of Mines estimates, the United States has sufficient known manganese ore reserves to supply our needs for at least the next hundred years.

These two situations, (1) importing most of our manganese, and (2) having large reserves of manganese ore, are not as incompatible as they seem at first glance. The explanation for this situation lies in the fact that almost all of our reserves are in extremely low grade ores (5 to 15 percent of manganese), whereas the imported ore comes from high grade deposits which contain in excess of 48 percent of manganese. The economics of steelmaking are such that the higher grade material is less costly to use and is, therefore, demanded by the steel industry. While our domestic low grade ores can be, in many cases, upgraded to yield concentrates containing 45 percent or more of manganese, this is, at present, a costly procedure and, obviously, where a high grade material is mined and shipped directly, it will have the economic advantage over an ore that must be mined and then concentrated before being shipped.

This situation is further aggravated by our high labor ocsts as compared to the cheap, though inefficient, labor in most of the foreign countries from which we import manganese. In all fairness, however, it should be pointed out that even with our higher standard of living and resultant higher labor costs, the United States has always managed to remain in a competitive world-wide position where our ore reserves have been equal in quantity and grade to those of the foreign producers. As an example, we probably produce iron ore cheaper than any foreign nation.

We have reached and maintained this competitive position through technical advancements which enable us to produce more material with fewer man-hours of labor. In many cases, this technical know-how has enabled us to hold our own even against superior ore reserves in foreign countries. For example, in the production of copper, we are competing on the world market even though much of our production is from ores containing less than 1 percent of copper as compared with foreign ores averaging several percent of copper.

Although, in the case of manganese, we may never be able to produce high grade concentrates as cheaply as some foreign countries can mine direct shipping ore, we should certainly be able to reduce our current domestic production costs providing we are willing to invest in a research program of sufficient magnitude to result in marked improvement in technology.

In the past, largely as a result of wartime emergencies, several such research programs have been started but, in each case, they have been allowed to die without reaching maturity simply because the wartime pressure ceased to exist. While many individual mineowners and producers have continued their efforts as individuals, even in times of peaceful existence, the size and scope of this problem is such that their efforts have failed to dent it. Indeed it appears that the problem can be met and solved only by a large-scale effort put forth on a long-range basis.

It is, therefore, my opinion that this committee would be well advised to establish a well-organized, long-range research effort aimed toward the improvement of technology in the treatment of domestic manganese ores which would put the United States in a position to satisfy its manganese requirements from domestic sources at a reasonable cost.

ANACONDA COPPER MINING CO.

Manganese nodulized ore

[Long dry tons]

	Production		Shipments	
	Tons	Percent Mn	Tons	Percent Mn
1950	101,765	58.908	106,871	58.910
1951	83,295	58.548	81,320	58.508
1952	80,905	57.333	81,046	57.471
1953	94,120	57.097	91,855	57.039
1954:				
January	8,582	56.617	6,484	56.634
February	8,086	57.648	4,720	57.586
March	7,911	58.072	3,675	58.249
April	5,899	57.159	3,929	57.214
May	9,251	57.935	3,304	57.981
June	9,468	57.845	3,523	57.945
July	7,219	57.471	3,128	57.799
August	4,545	58.075	2,117	58.254
September				
October			273	56.541
November			247	57.800
December			8,542	57.437
Year 1954	60,961	57.596	39,942	57.535
Total, 5 years	421,046		401,034	

STATEMENT BY SENATOR ALAN BIBLE ON BILLS TO EXTEND DOMESTIC MINERALS PROGRAM EXTENSION ACT OF 1953

It is my desire to impress upon this committee what I believe is the necessity for passage by this Congress of pending legislation extending the present domestic minerals purchase program in order to strengthen national defense and to encourage the discovery, development, and production of certain domestic minerals.

My bill, S. 1583, plus several others before your committee, concerns the domestic production of tungsten, manganese, chromite, mica, asbestos, beryl, and columbium-tantalum-bearing ores and concentrates pursuant to the Defense Production Act of 1950, as amended, and the Strategic and Critical Materials Stockpiling Act of 1946, as amended.

It has been said in previous years by some of the executive agencies that existing authority contained in title III of the Defense Production Act of 1950, as amended, permits appropriate programs for all strategic and critical minerals without passage of the legislation I have mentioned. Even if it be true such authority does exist, it is self-evident that securing affirmative action by executive agencies to institute or continue a needed program is entirely another matter.

Unless the Congress can spell out its wishes in this regard, too often an executive agency is adamant about proceeding. Certainly, the present state of the domestic fluorspar industry is an example of this situation.

Under legislation now before your committee, American producers of tungsten, manganese, chromite, and other strategic and critical minerals set forth in the bills mentioned would be given a period of certainty during which they can plan and invest in a businesslike manner toward achievement of the production goals set for them. To accomplish this purpose, S. 1583, S. 1543, S. 922 and others would extend the programs established under the Defense Production Act, as amended, a period of 7 years or until June 30, 1962, a date corresponding with the expiration of the Defense Production Act.

Continued operation of present purchase depots and the establishment of new depots to carry out the policies of the basic Domestic Minerals Program Extension Act of 1953 would be carried out.

It must be remembered that extension of this program, as proposed, will benefit a domestic mining industry hard hit by record high imports of cheaply pro-

duced minerals. It is a self-evident truth that an active domestic mining industry is just as important for peace and for defense as it is for war. Our dependence upon foreign sources must be abrogated in every way possible. Therefore, this domestic purchase program must be continued.

STATEMENT BY L. S. HOLSTEIN, VICE PRESIDENT, THE NEW JERSEY ZINC CO., NEW YORK, N. Y.

The New Jersey Zinc Co., since 1882 engaged primarily in mining and smelting zinc ores, is a factor in the manganese field merely because for a long time it has been a producer also of spiegel iron—an alloy of iron and manganese, the manganese content conventionally being from 19 to 21 percent. Spiegel iron is used in the iron and steel industries for its manganese content.

The company produces spiegel iron from ores mined by it in northern New Jersey, which contain a mineral—unique in its occurrence there—composed of zinc, iron and manganese compound. Those ores are transported to Palmerton, Carbon County, Pa., for smelting primarily for their zinc content. The manganese-bearing zinc mineral referred to is treated first for the extraction of the zinc. The remainder, with the addition of limestone and coke, is then subjected to treatment in a blast furnace for the production of spiegel iron.

The company's raw material situation is undergoing change. For more than 50 years its source of manganese raw materials was the Franklin mine in Sussex County, N. J., but that mine has now been exhausted. A nearby one, the Sterling mine at Ogdensburg, N. J., is being brought up to increased production this year. Its ores differ somewhat from the Franklin ores, both mineralogically and in manganese content, but after they are smelted for zinc, a product is obtained that is sold to the steel companies for its manganese content. Moreover, there is on hand at Palmerton a large stock of these New Jersey ores, also manganese-bearing residues remaining after the extraction of zinc, that will serve for several years.

It will be recognized from this statement that our position in the manganese field is quite circumscribed. We have been concerned only with the utilization and disposition of manganese as a lesser constituent of one of our many zinc-bearing ores. We have had no experience in the mining, milling or smelting of manganese ores, or in the production of other manganese products—that is, other than spiegel iron—except in an experimental way.

STATEMENT OF H. F. LYNN, PRESIDENT, MOHAVE MINING & MILLING CO.

This following testimony is offered in behalf that it is necessary to the interest of national defense to develop a domestic manganese industry, adequate to substantially support the steel capacity at maximum demand for a period of several years. It is also my belief that the Defense Production Act of 1950 and Public Law 206 were laws beneficial toward this end and although too small in scope to offer both in time and quantity to arrive at this end sought, did materially advance toward the objective. It is my considered opinion that these laws were badly administered either through ignorance, incompetence or lack of sympathy to the end that the mandate of Congress was to a great extent contravened. Despite the unfriendly administration, the miner has diligently prosecuted his trade, mostly without overall profit and has accomplished much of that sought by Congress. The production has steadily increased, with ores capable of being beneficiated to specification grade by simple physical methods; new areas and new deposits have been opened up, some of which were described as barren by Government reports; new beneficiation plants have been erected at considerable capital expenditure with no call for Government financing, exploration in new areas has been initiated, and required capital is being attracted in greater quantities. It is my conviction that if the program is allowed to continue for several years more with an increased appropriation, a sound manganese industry will be founded on lowgrade ore with a price for the finished product competitive in world markets. Our marvelous developments in the profitable handling of the low grade copper ores and the taconites were not evolved over night. To consummate this objective, Congress must pass laws that will give both

adequate time and a profitable market sufficiently large to amortize the capital required to convert our low grade deposits into end products at competitive prices and utilizing labor at adequate compensation.

After these bills are passed, Congress must have some "watch dog" policy to see that its mandate is carried out and that the law is not contravened by irrational, incompetent or unsympathetic administration. The tenets of the law must be explicitly stated in order to avoid the light hearted, casual and incompetent administrative regulation that implemented the existing laws. There should be no tacit admission of administrative regulations into law by omission of reference thereto. The campaign of vilification of the law and misrepresentation of the practical results of the operation of the law, by written word and word of mouth as enunciated by administrators sworn to uphold and implement the law, must be stopped. The law should effectively stop the rule by whim of administrative heads and return to constitutional procedures. Declaration of policy by itself is not enough. From past experience, the law must be spelled out in order that it becomes effective under unsympathetic administration. Further, the law should provide independence from foreign supplies to national stockpile. The manganese mining industry cannot pay taxes to subsidize coolie and slave labor operations through the medium of price supported foodstuffs bartered at reduced value, and remain competitive at this early stage of its career.

This testimony is therefore, offered in support of new legislation extending and explicitly implementing the mandates. Senate bill 920 and House of Representatives bill 3126 fill practically all the requirements I believe necessary. I believe the passage of these bills will bring about a strong and competitive domestic manganese industry.

Now, in conclusion, I would like to lay in rest some specters. As I walk the limitless halls of Government agencies, I hear of the "unconscionable profits" being made by manganese miners due to the "extraordinary subsidy" paid as a "handout." I do not know of these profits and I do not know of anyone that has made this type of profit. Certainly not the small operator who has done the spadework for the development of the industry.

On my own company's part, we have ploughed such small profits that we have made back into equipment to make our operations more efficient in order that we may be ultimately competitive on world markets. In that regard, when we consider prices f. o. b. United States, we must give to domestic operators, credits for Federal and State income taxes, corporation taxes, excise taxes, property taxes, sales taxes, transportation taxes, and social security taxes paid. We must credit the wage differential between one providing the amenities of life and that of coolie or slave labor affording only meager subsistence. We must also credit the cost of maintaining men on the unemployment roles. We must also credit national defense. Perhaps this campaign for "cheap" foreign manganese is a luxury we can ill afford.

Another common statement of Government agency executives is that there is no known method of beneficiating the ores purchased by the Wenden Depot and that it will always remain as a "white elephant" in commemoration of the folly of the Government manganese purchase program. Since these ores were exhaustively tested by simple physical beneficiation methods and proven to produce concentrates of specification grade, one can only speculate on the motive behind the obviously false statements. The tests were conducted by competent Government agents. At this time, I wish to state, my company would like to negotiate a contract for the physical beneficiation of these ores. I have already made this offer to the appropriate Government agencies.

Finally, I would like to have greater assurance that the national manganese stockpile is adequate for national defense than that of the very people who were so wrong in their prediction of the potential productivity of the areas contiguous to the receiving depots. A mistake in this estimate will be more than inconvenient, it will be fatal. One can readily understand the confidential nature of this information, but in view of the great consequences of incorrect estimates, it is to be hoped that Congress itself will make an independent check on these resources.

MANGANESE CHEMICALS CORP.,
Cleveland, Ohio, April 25, 1955.

Mr. JEROME ADLERMAN,
Counsel to Minerals Subcommittee of Committee on Internal and Insular Affairs, Senate Office Building, Washington, D. C.

DEAR MR. ADLERMAN: Enclosed herewith is a statement by Mr. B. R. Babbitt, vice president and general manager of Manganese Chemicals Corp., with respect to our company's affairs relating to our leaching process and the production of high grade manganese concentrates from low grade American ores.

As you know, Mr. Babbitt was called as a witness before your committee, and we promised to submit this statement to you.

We trust that you will find that this answers your requirements. However, if there is any additional information which the committee would like to have, we would be glad to do our best to supply the same.

Very truly yours,

MANGANESE CHEMICALS CORPORATION,
By J. P. BROWN, *President.*

MANGANESE CHEMICALS CORPORATION

This company is now operating a plant on the Cuyuna Range at Riverton, Minn., for the production of manganese concentrates from the ore deposits in that area. The operation employs a chemical leaching method known as the Dean-Leute ammonium carbonate process. The plant was constructed and is operated by a combination of Government and private funds and was built as a pilot plant to test out the leaching process referred to above.

The plant has a capacity to treat 200 tons per day of crude ore, producing about 24 tons of concentrates per day. The initial product recovered from the leaching process is a pure manganous carbonate. This material is disposed of in several ways:

1. Part of it is sold to private industry as carbonate.
2. Part of it is converted to various high grade industrial oxides (including battery dioxide) and is sold to private industry.
3. Part of it is converted by a balling and roasting process into hard pellets.

The pelletized manganese concentrates are now being shipped to the Government stockpile. They have the following analysis:

Manganese, 65 percent.
Phosphorus, .005 percent.
Iron, 1.2 percent
Silica, 2.5 percent.
Alumina, 1.0 percent.

The pellets are excellent material for the manufacture of high grade ferromanganese for use in the steel industry. The manganous carbonate can also be used as a basic material for conversion into electrolytic manganese dioxide, electrolytic manganese metal and various other manganese compounds.

The concentrates produced in this plant are exceptionally high in manganese, running from 64 percent to 68 percent, as compared with 50 percent or less in ores now imported for the steel industry.

It is quite possible that blending concentrates produced by this process with low grade ores acquired under the Government purchase program may present the most practical and cheapest means of utilizing some of these stockpiles. It is also possible that such low grade ores could be leached by this process to produce high grade concentrates.

The plant is now operating on Cuyuna Range ores, having the following analysis:

Manganese, 7 to 10 percent
Iron, 25 to 28 percent
Phosphorus, 0.150 to 0.250 percent
Silica, 27 to 35 percent

Laboratory tests have shown that the process will also work on practically any of the oxide or carbonate ores from other parts of the country. Blast furnace slag or silicate ores require a lime roast before leaching.

The operations at our plant have demonstrated this process to be technically sound both from a chemical and operational standpoint. Commercial-sized equipment has been used throughout the plant. In the event of the construction of a larger plant, multiples of the same equipment would be used.

It is not expected that manganese can be recovered by this process from low grade ores as cheaply as the price paid for ores which are now being imported from foregin countries. However, it is a means of producing within our own borders usable high grade manganese concentrates from our own domestic ore supply.

The Cuyuna Range is one of the largest known sources of manganese material in our country. It is an area from which millions of tons of iron ore are mined and shipped by way of the Great Lakes to the steel mills.

The operation of this plant to date and this workability of the process indicate that any plans to expand our domestic production of manganese should include consideration of a large plant on the Cuyuna Range.

MANGANESE CHEMICALS CORPORATION
By B. R. BABBITT
Vice President and General Manager.

(Whereupon, at 4:10 p. m., the hearing was adjourned.)

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